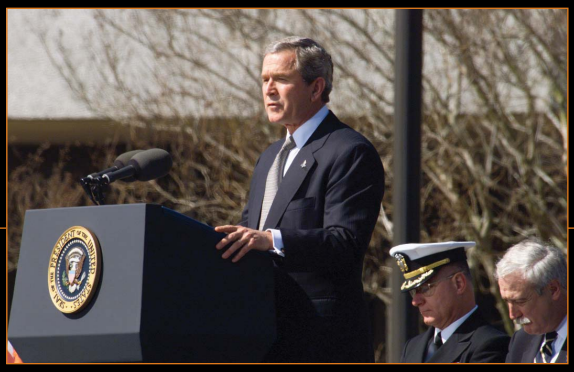
National Aeronautics and Space Administration

Space Flight Enterprise Strategy

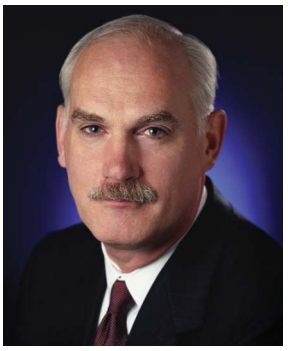
"To leave behind Earth and air and gravity is an ancient dream of humanity . . . . This cause of exploration and discovery is not an option we choose; it is a desire written in the human heart. We are that part of creation which seeks to understand all creation. We find the best among us, send them forth into unmapped darkness, and pray they will return. They go in peace for all mankind, and all mankind is in their debt."

—President George W. Bush,
February 4, 2003



A Message from the Associate Administrator for Space Flight

November 1, 2003



Dear Colleagues and Friends:

Forty-five years ago, the quest to put humans into space became the raison d'etre for the formation of a new federal agency—NASA. That proud heritage and the quest to explore the unknown endure to this day.

The Space Flight Enterprise is the foundation for all NASA's activities in space.

We provide space transportation for human and robotic exploration and scientific missions, in-space laboratories for research, and the means to return scientific data to Earth.

We are the people who enable all the hardware and software to come together and operate in space in an integrated fashion to accomplish the NASA Mission: "To understand and protect our home planet, to explore the universe and search for life, and to inspire the next generation of explorers . . . as only NASA can."

We feel privileged to explore in space on behalf of all Americans. Our aim is to share the exploration experience—the triumphs and tragedies, the inspiration of discoveries and the scientific harvest—with all Americans.

The loss of Columbia and her crew this past February following their highly successful voyage of scientific discovery was one such tragedy. But, there will be future triumphs. We as an Agency and as members of the Space Flight team vowed to find the cause, fix the problems—addressing hardware failures and human failures—and return to flying safely again.

Shuttle flights will resume. We will complete the construction of the International Space Station and enable a robust research program to thrive in space. Our support of the broader missions of the Agency in the sciences, technology and education will continue, enabling future exploration, discovery and understanding.

In so doing, we will define not only the future of our Enterprise, but also the course of space exploration. We aim to use this occasion to reinvigorate our commitment to space flight and come back smarter, stronger and safer.

The future will be vibrant.

William Readdy

William F. Readdy
Associate Administrator
for Space Flight

We dedicate this strategic document to the members of the NASA family who have lost their lives pursuing humankind's intrepid journey into space. We will not forget their efforts or the mission they strove to accomplish.

"Although we grieve deeply, as do the families of Apollo 1 and Challenger before us, the bold exploration of space must go on. Once the root cause of this tragedy is found and corrected, the legacy of Columbia must carry on—for the benefit of our children and yours."

—Statement by the families of the Columbia STS-107 crew, February 3, 2003

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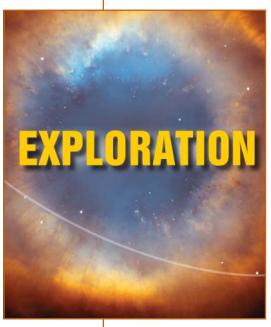
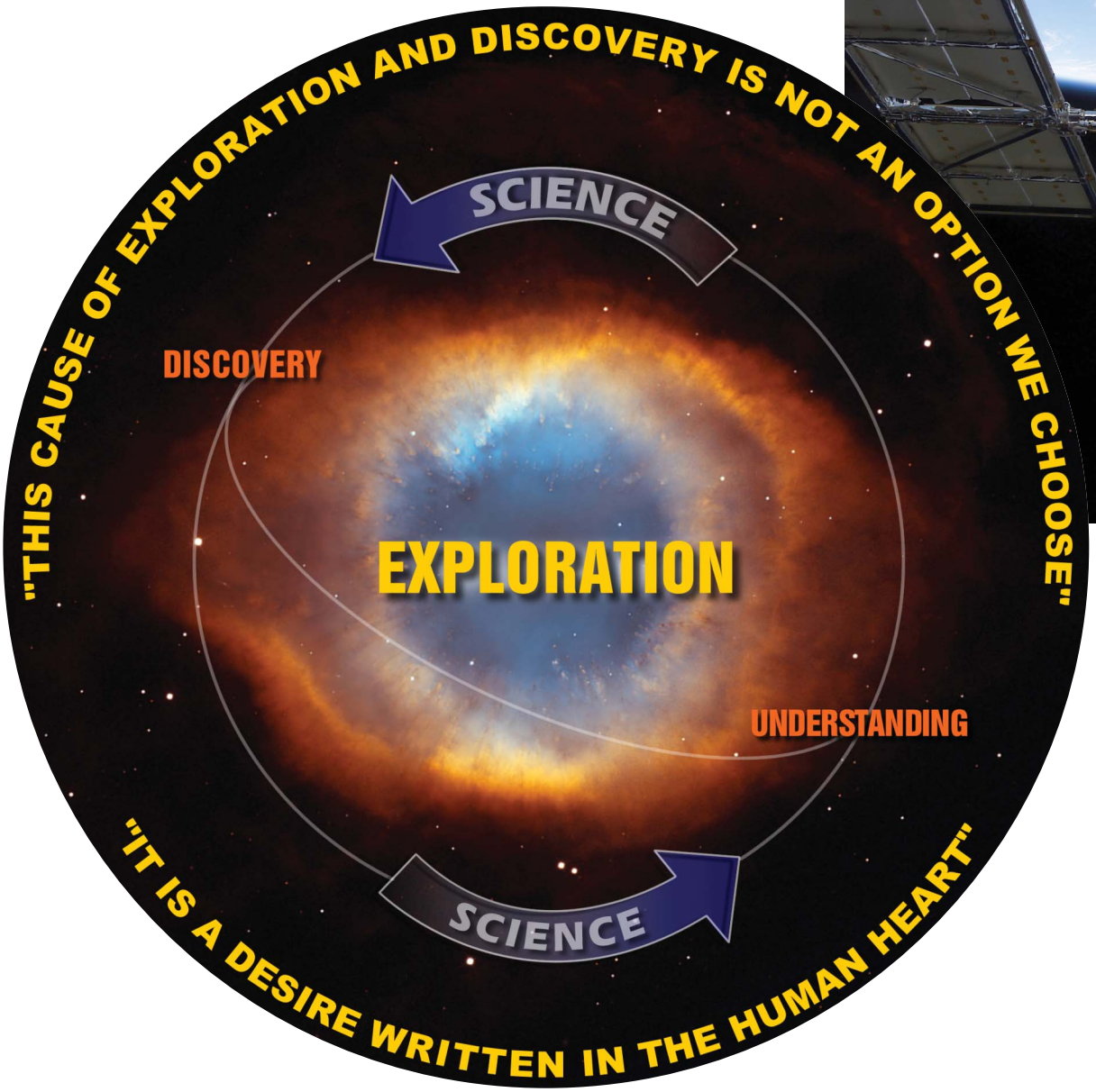


1 The Space Flight Enterprise in NASA's Vision and Mission

Exploration Enables Science

As we explore, science leads to discovery and understanding.

Through education and outreach, we share the experience with all Americans.



Astronauts repair and service the Hubble Space Telescope (above). In the figure to the left, the background is the Helix nebula as observed through Hubble.

1 The Space Flight Enterprise in NASA's Vision and Mission

Enabling the Vision and Mission

The Space Flight Enterprise draws its purpose from the National Aeronautics and Space Administration's overarching Vision and Mission. NASA seeks to **improve life here, to extend life to there,** and **to find life beyond**.

Derived from this Vision, the NASA Mission is **to understand and protect our home planet, to explore the universe and search for life,** and **to inspire the next generation of explorers . . . as only NASA can**.

In support of the NASA Vision and Mission, the Space Flight Enterprise will marshal its efforts around a key transformation that is outlined in NASA's Strategic Plan:

Space flight will enable research, discovery, and understanding.—In the early days of NASA, the demonstration of human space flight was a national priority motivated by the need to prove American technological preeminence. This demonstration led to some of the most spectacular achievements in human history, and during the past 4 decades, NASA has systematically developed the capability to live and work in space. With the Space Shuttle, the International Space Station, and a variety of other space capabilities, we now have tools that enable a quantum leap in the utilization of the unique environment of space for scientific research.

Human space flight will always be an integral and critical element of our strategy for space exploration. NASA will continue to expand its human presence in space—not as an end in itself, but as a means to further exploration, discovery, and understanding.

Note: All subsequent image captions are in appendix 2.

The Role of the Enterprise

We feel privileged to provide access to space, now and in the future.

The Enterprise's Primary Contributions to NASA Goals

- Ensure the provision of space access and improve it by increasing safety, reliability, and affordability (goal 8).
- Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery (goal 9).
- Enable revolutionary capabilities through new technology (goal 10).

—From the NASA Strategic Plan

The Space Flight Enterprise provides the foundation for NASA's space programs—space travel for human and robotic missions, in-space laboratories, and the means to return data to Earth. We strive to provide space access for our customers with a high standard of safety, reliability, and affordability. We seek to broaden the scope of research by extending the duration and boundaries of human space flight and developing revolutionary capabilities for future exploration. Embracing both joys and heartaches, we share the experience of exploration with all Americans.

Achieving space flight can be astonishing. An undertaking of great complexity, it involves nearly every technological and engineering discipline and requires a high level of organizational skill.

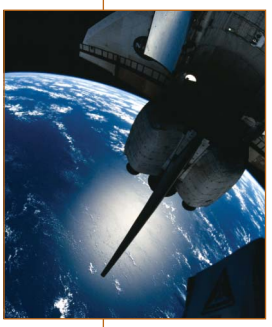
Overcoming Earth's gravity to achieve orbit demands the rapid release of an enormous amount of energy under the precise control of sensitive instruments. The harsh environment of space puts tight constraints on the equipment needed to perform the necessary functions. When a human crew is present, a livable environment is required—air, water, food, a comfortable temperature, and waste management, as well as the electrical power and control to supply and maintain these provisions. The systems providing these staples of life must have a high degree of functional reliability and interdependence, a level that demands every effort to minimize risk.

Remarkable people are required to deal with the demanding and frequently conflicting requirements of space flight. Knowledge, imagination, creativity, ingenuity, curiosity, discipline, professionalism, thoroughness, and balance are some of the qualities needed. These people must also be focused, painstaking, and ever-vigilant, even in success.

We are fortunate. Thousands of engineers, scientists, technicians, managers—professionals of all stripes—respond to the challenge of space flight by enlisting in this great adventure, some as civil servants and thousands more as contractors. Our people are our greatest asset.

The Space Flight Enterprise: Who We Are

We provide space access for all NASA's activities in space. We operate the International Space Station and the Space Shuttle. We arrange for the launch of NASA science missions on expendable launch vehicles and manage communications networks in space. Our employees are located at NASA Headquarters and at four space flight Field Centers: Johnson Space Center in Texas, Kennedy Space Center in Florida, Marshall Space Flight Center in Alabama, and Stennis Space Center in Mississippi. Our Field Centers and employees are dedicated to advancing exploration, discovery, and understanding on behalf of the American people.



2 Strategic Context and Approach: A Leadership Vector

"[There] will be a vibrant space program with new missions carried out by a new generation of explorers . . . . In doing so, we honor the heritage of our country and help shape the future of all mankind."

—Vice President Richard B. Cheney, February 6, 2003

2 Strategic Context and Approach: A Leadership Vector

"Somewhere, something incredible is waiting to be known."

—Carl Sagan

Building on our current strengths and drawing on new sources, the Space Flight Enterprise will advance human and robotic exploration. Our leadership vector encompasses four areas of emphasis that will carry us toward our future:

Commitment to Flight

Our commitment to space flight is firm. Through outstanding engineering, enhanced safety processes, and international cooperation, we will explore as judicious risk-takers.

Corporate Focus

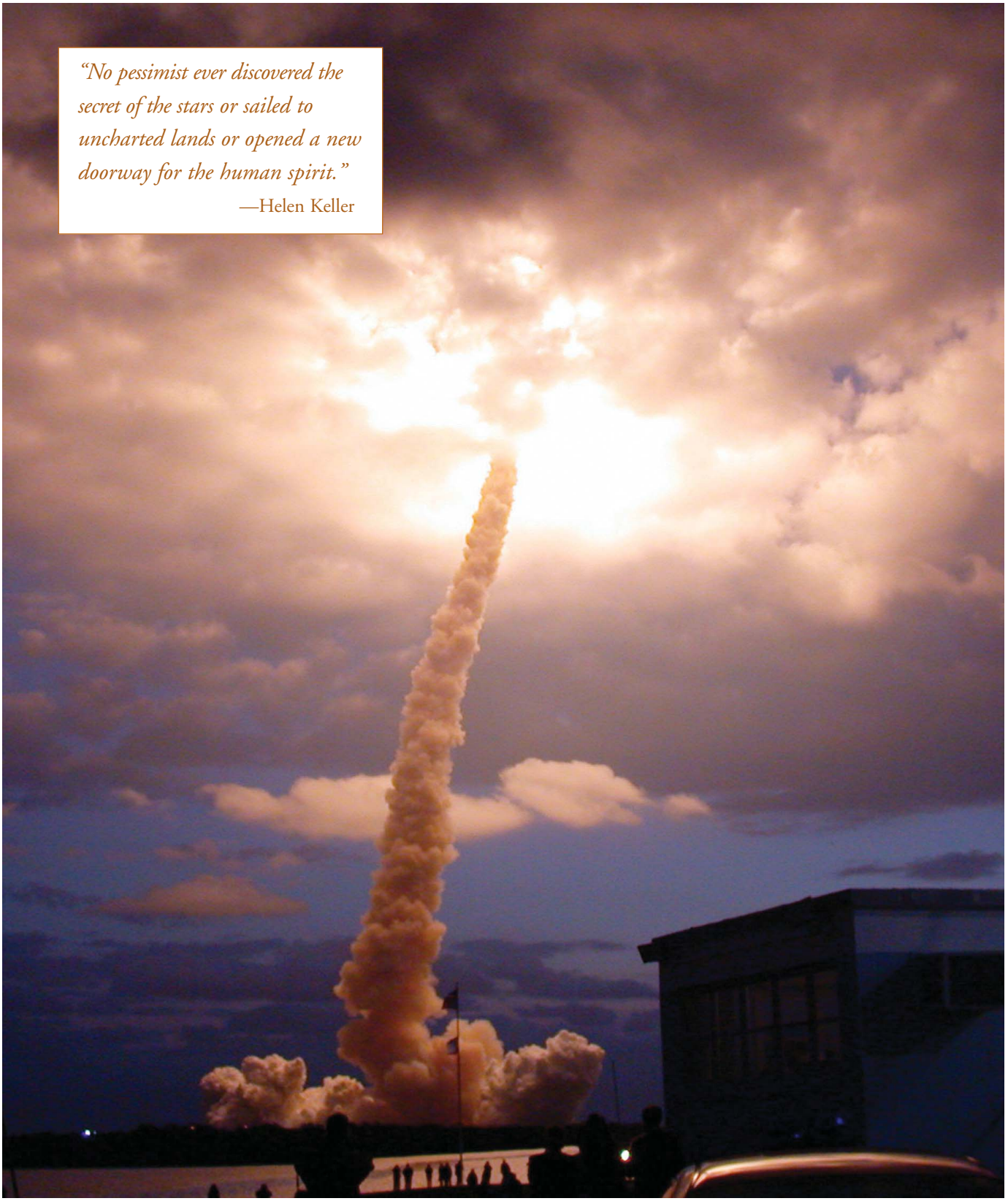
We are an integrated organization with a common purpose. Our common focus is to provide space flight capabilities that further NASA's goals, now and in the future.

Management Excellence

We will maximize the taxpayers' return on their investment by deploying state-of-the-art management tools to enable constructive leadership of our programs and allocate resources responsibly.

Reaching for a Vibrant Future

Through our commitment to space flight, a refined corporate focus, and management excellence, we are developing the foundation for our future. We will enhance our capabilities so that we can respond with speed and agility when new opportunities for exploration arise. Our future will be vibrant.



"No pessimist ever discovered the secret of the stars or sailed to uncharted lands or opened a new doorway for the human spirit."

—Helen Keller

Commitment to Flight

As explorers and pioneers, our commitment to space exploration is firm. Human space flight—as only NASA can—is essential for the U.S. space program. The Space Flight Enterprise is committed to advancing NASA's scientific and exploration goals for the benefit of Nation.

Through technical rigor and rigorous safety processes, we will understand and mitigate risks to missions and crew. We will restore confidence in America's space program by successfully resuming Shuttle flights. The lessons that we learn will strengthen all of our programs and all of our Field Centers.

As soon as we have taken necessary measures to improve safety, our Shuttles will resume flights to the International Space Station (ISS). By relying on the Shuttle fleet and international cooperation, we will complete the construction of the Space Station so that vigorous research can flourish. We will then endeavor to extend the service life of the Shuttle fleet so that we can expand research on the Space Station and advance other scientific missions, like the Hubble Space Telescope. We will do this through the Shuttle Service Life Extension Program. Formulated as an inclusive forum drawing together NASA departments and Centers, other Federal agencies, and the private sector, this program will prioritize projects and processes that will enhance the Shuttle system and incorporate plans for a new crewed vehicle.

We will also advance scientific discovery by continuing to arrange for space access on expendable launch vehicles (ELVs). We will rely upon ELVs to meet a robust schedule for the launch of robotic space science and Earth science missions. In addition, we will provide space communication services that support NASA's scientific and exploration missions. We will also test and deploy safe, affordable and effective advanced space systems that will facilitate new exploration, discovery and understanding.

Safety First

Our commitment to flight requires that we ensure risk-managed access to space for our customers, including all other NASA Enterprises. Risk management requires that we focus first on safety and then on other objectives.

Because we know that exploration is inherently risky, we rely on risk management plans to mitigate risks and on contingency plans to respond to that risk. When problems occur, we identify the underlying cause; fix the problem; and return to operations, while managing risk and promoting safety.

Along with resolving the specific problem, we prevent other problems from arising by applying new understanding to analogous situations.

Our response to the Columbia accident evidences our approach. We requested, welcome and embrace the Columbia Accident Investigation Board's Report. We will comply with its recommendations and take additional action to enhance flight safety in all of our programs. This includes increasing the independence and quality of our flight risk analysis and enhancing our safety culture.

Safety: A NASA Core Value

NASA's mission success starts with safety. We are committed to protecting the safety and health of the general public, pilots and astronauts, the NASA workforce, and our high-value assets on and off the ground.

—From the NASA Strategic Plan

We will implement recommendations for improvement by coordinating closely with NASA's Office of Safety and Mission Assurance. In addition, we will work closely with the newly established NASA Engineering and Safety Center based at Langley Research Center. These two organizations enhance the safety of all NASA activities though the development and oversight of Agencywide procedures. This process involves reviewing our programs on an independent basis, creating and implementing cutting-edge test and evaluation techniques, and checking our work against established standards. These safety reviews help us minimize risks and greatly enhance the potential for success in all aspects of space flight.

To sustain safe flight operations we will adopt technical, managerial and cultural changes. The specific steps that we will take are outlined in NASA's Implementation Plan for Return to Flight and Beyond. The Implementation Plan is available to the public through the internet at *www.nasa.gov*, and it will be updated regularly.

Corporate Focus

The Space Flight Enterprise is a large organization, comparable in size to Fortune 500 corporations. We have about 7,000 public service employees and many more contractor employees, $9.5 billion in assets, and an annual budget of $6 billion. Our corporate focus, which is based on what we produce and for whom we produce it, unites us.

We are an integrated organization that provides space access for all other Agency organizations. We focus on customer service to enable scientific accomplishment and to educate and inspire future explorers. We share our expertise with NASA Enterprises that are engineering some of our future capabilities. In partnership with the rest of NASA, we create, test, and deploy building blocks for future exploration, discovery, and understanding.

Transformation

We will operate as One NASA in pursuit of our Vision and Mission.

NASA is a large Agency, consisting of thousands of public servant and contractor employees, Field Centers across the United States, and facilities in foreign countries. With our new focus on a unified long-range Vision and Mission, it is imperative that all elements of the Agency work together as a single team.

—From the NASA Strategic Plan

Providing Space Flight Services

We open the gateway to space for a wide range of customers including all other NASA Enterprises, as well as our international partners, other Government agencies, and the private sector. We offer our customers a complete suite of space flight services ranging from launch facilities and support of space-based research and education initiatives to on-orbit assembly of space assets. Our services are listed in the following chart.

● Primary customer support
❍ Secondary customer support

Service	Provided to								
	Biological & Physical Research Enterprise	Earth Science Enterprise	Space Science Enterprise	Aerospace Technology Enterprise	Education Enterprise	Other Government Agencies	International Partners	Private industry	Academia
Providing spaceport launch facilities and services	●	●	●	❍	❍	❍	❍	❍	❍
Operating the Space Shuttle	●	❍	●	❍	❍	❍	●	❍	❍
Assembling and managing logistics for the ISS	●	❍	❍	❍	❍	❍	●	❍	❍
Conducting experiments on the ISS and Shuttle	●	❍	❍	❍	❍	❍	●	❍	❍
Launching and servicing space observatories		❍	●		❍	❍	❍	❍	❍
Launching spacecraft on expendable launch vehicles	❍	●	●	●	❍	●	❍	❍	❍
Processing and integrating payloads	●	●	●	❍	❍	●	❍	❍	❍
Providing communications and data services	●	●	●	●	●	●	❍	❍	❍
Performing rocket propulsion testing	❍	❍	❍	●	❍	❍	❍	❍	❍
Operating technology test facilities on the ground and on the ISS	●	❍	❍	●	❍	❍	❍	❍	❍
Developing advanced space and ground systems	●	●	●	●	❍	❍	❍	❍	❍
Ensuring astronaut and crew health and safety	●	❍	❍	❍	●	❍	❍	❍	❍
Operating visitor centers at KSC, JSC, MSFC, and SSC*	❍	❍	❍	❍	●	❍	❍	❍	❍

*KSC: Kennedy Space Center; JSC: Johnson Space Center; MSFC: Marshall Space Flight Center; SSC: Stennis Space Center

Transformation

Education and inspiration will be an integral part of all our programs.

—From the NASA Strategic Plan

Sharing with the Public

To ensure continued advances in exploration, discovery, and understanding, we contribute to the education and inspiration of future generations. We do this by working closely with NASA's Education Enterprise and the Office of Public Affairs.

NASA's Educator Astronaut Program trains selected K–12 teachers as astronauts so that they can teach in the space environment and share their experiences with students. In addition, our astronauts, engineers, and scientists participate in educational and outreach activities across the country. We share information with the public through the Internet, participate in seminars, and develop educational material for distribution to schools. Often serving as a catalyst for public interest in the space program, visitor centers under the aegis of the Space Flight Enterprise attract a large cross section of the public and provide access to a wide range of NASA activities.

The bold space frontier captivates the public. That is why news and media outlets often turn to NASA for technical support. The Space Flight Enterprise will continue to collaborate with media companies so that as many Americans as possible can experience space exploration.

Additionally, the Space Flight Enterprise actively seeks opportunities for cooperative education and training with universities. The Enterprise develops its advanced systems in close cooperation with universities so that we may blaze a trail together into the future and captivate the minds of the next generation of engineers and scientists.

Obtaining Support from Other Organizations

The Space Flight Enterprise benefits from the expertise of other organizations. Examples are:

- NASA's Space Science Enterprise and the Aerospace Technology Enterprise are developing optical communications technologies that will vastly improve our communications infrastructure.

- NASA's Biological and Physical Research Enterprise is researching next-generation systems that will enable humans to live longer in the harsh environment of space.

- NASA's Aerospace Technology Enterprise will be designing an Orbital Space Plane that will be transferred to the Space Flight Enterprise for in-flight use.

- The Space Science Enterprise's Mars exploration program will facilitate possible future human exploration.

- The Department of Defense (DOD) and industry are continually developing a variety of new space technologies that we will evaluate for possible use.

- Companies regularly provide contractual services that improve our systems.

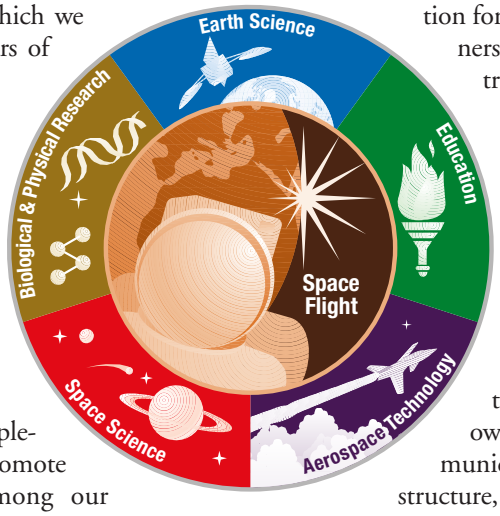
- Our international partners will provide key components that will expand the capabilities of the Space Station.

See appendix 1 for additional information.

Creating Building Blocks for Future Exploration, Discovery, and Understanding

We are intimately involved in Agencywide efforts to create new capabilities. We actively participate in task forces that are designing the building blocks for future exploration. We share insights and techniques, which we learned from our many years of working in space.

Further, we develop, test, and deploy revolutionary advanced space systems, including innovations in space communication that will support future space operations.



Synergy

We will develop and implement mechanisms that promote cross-pollination both among our organizational components and with other NASA Enterprises.

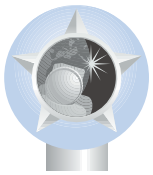
To this end, we have placed our Space Shuttle and International Space Station Programs under the leadership of one executive. This structural change will allow us to integrate the two programs on a fundamental level.

To boost motivation and foster a greater sense of corporate identity among our Field Centers, programs, managers, and employees, we will provide opportunities for mobility. We will also reward employees for contributions to our corporate focus, especially when contributions promote cooperation.

We will deploy information technologies that promote common understanding. Chief among these is the "One NASA" Management Information System, a new tool designed to enhance and sharpen management processes. Members of all organizations will look to this tool to provide benchmarks, current information, and timely status reports.

To encourage an open and wide-ranging exchange of information and capabilities among Enterprises, we will assign liaisons throughout our organization. Our Launch Services Program will serve as the principal customer interface between the Space Flight Enterprise and those organizations that rely on us for space access. By requesting and analyzing customer opinions, we will strive for continuous improvement in all of our programs.

We also will establish a sound foundation for the future by forming partnerships with academia, industry, and other Government agencies. Innovative partnerships enable us to educate and inspire the next generation of explorers, as well as to develop dual-use technologies that advance the NASA Mission and protect our home planet. By leveraging these partnerships with our own assets, such as our communications and facilities infrastructure, the Space Station, and the Shuttle, we will spawn new capabilities for exploration, discovery, and understanding.



Management Excellence

Through excellence in management, we will foster leadership of programs and Field Centers. Delivering value will be the overarching management focus of our programs and institutions.

Managing Value and Promoting an Inclusive Culture

As we seek to optimize performance, our aim will be to maximize the value we provide to our customers and, ultimately, the Nation. We will strive to provide ensured space access, inspiration and education, new knowledge and technologies, and opportunities for commerce. To maximize the value of the services that we provide, we will promote a culture that encourages open communication, especially about flight safety issues.

The President's Management Agenda

We will use the President's Management Agenda to stimulate excellence in all of our activities. NASA offices are developing expertise, "best practice" manuals, and roadmaps for all aspects of management. An Agencywide Strategic Human Capital Plan has already been issued; other Agencywide management plans are under development, including a Real Property Strategic Plan. For information about the responsible offices for these Agencywide activities, see appendix 1.

Freedom To Manage

Excessive control and approval mechanisms afflict bureaucratic processes . . . . As the barriers to more efficient management are removed, we will expect higher performance. With Freedom To Manage will come clear expectations of improved performance and accountability.

—From the President's Management Agenda

Included in this agenda is the President's Freedom to Manage initiative. We will take care not to overburden our staff with inflexible procedures that stifle creativity or discourage open communication. Instead, our aim will be to create an innovative, inclusive, and flexible organization.

Implementing Strategies

All NASA activities are based on a foundation of sound planning and management practices derived from the President's Management Agenda. NASA's implementing strategies are similar in intent to management strategies of all well-run organizations.

The NASA Implementing Strategies are as follows:

- Achieve management and institutional excellence comparable to NASA's technical excellence
- Demonstrate NASA leadership in the use of information technologies
- Enhance NASA's core engineering, management, and scientific capabilities and processes to ensure safety and mission success, increase performance, and reduce cost
- Ensure that all NASA work environments, on Earth and in space, are safe, healthy, environmentally sound, and secure
- Manage risk and cost to ensure success and provide the greatest value to the American public

—From the NASA Strategic Plan

Leveraging Our Excellence in Engineering

We will manage well by building on and reinvigorating our engineering expertise. When we design a new spacecraft we do not try to optimize the performance of every subsystem. Instead, we use systems engineering to evaluate resource and performance trades between subsystems in order to optimize overall performance.

As we enhance our management processes, we will apply similar systems engineering principles to analyze fiscal, capital, and human resources. We will use Agencywide tools to optimize overall management. By applying these capabilities—human resources, financial expertise, information technology, and facilities—we will return the greatest value to the American public.

Human Resources

People are our most important resource. The Space Flight Enterprise has attracted some of the best talent in the world; however, many of our most experienced employees will be retiring soon. We are working with NASA's Office of Human Resources to identify the skills we need in order to execute safe and successful space missions. We will define the competencies that we must retain and those that industry, academia, and others can supply. We also will develop the skills of our existing workforce and use every resource to attract new talent in essential areas.

In our quest to attract and keep talent, we will consider both current programs and future initiatives. This effort involves addressing pending retirements by planning for succession, as well as educating and inspiring the next generation of space engineers, scientists, and explorers.

Financial and Performance Integration

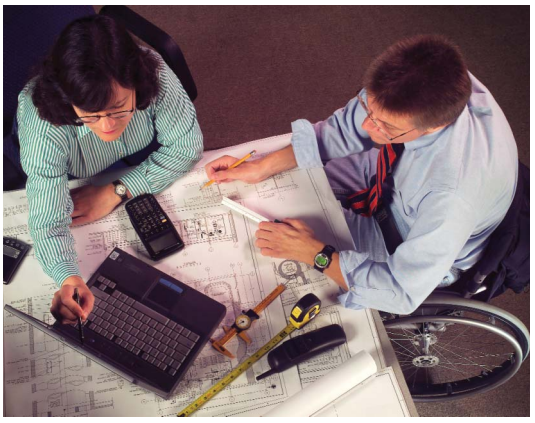
In the recent past, our financial systems and capabilities have not kept pace with our technical excellence. We have already begun to integrate performance planning and reporting with the budget process. To facilitate this integration, we have reworked our programs to reflect full-cost accounting. With a successful shift in our accounting and budgeting practices, we can better evaluate management choices and contractor services by implementing several concrete measures. We will do the following:

- Enhance systems and capabilities that evaluate costs and measure performance
- Analyze our major projects at the program level
- Support the implementation of NASA's Integrated Financial Management Program within the Space Flight Enterprise and across all Space Flight Centers
- Promote efficiency, improve continuously, and create the capacity for new development and deployment activities

Information Technology

Information technology (IT) allows us to share information reliably and streamline management processes. Revamped IT management strategies will enable our Enterprise to develop interoperable information systems across our programs and Centers, integrate inconsistent or overlapping systems, and make judicious decisions about investments in advanced IT infrastructure. We also will explore the use of IT to provide improved services to our customers.

The evolution of IT infrastructure in space will take longer than on the ground. Radiation in space creates special challenges for the electronic components of space-based IT applications. In this area, we will continue to rely on space-tested IT systems developed years ago while supplementing existing systems with newer and faster components that we can test in space without risking a disruption of safety-critical IT infrastructure.



Effective Use of Space Flight Centers and Facilities

Headquarters executives who lead our programs rely upon a portfolio of capabilities at each Center.

Using full-cost accounting, program executives will promote efficiency and discourage duplication by using program budgets to acquire needed personnel and services from the Centers. Program executives rely on specific capabilities at the four Space Flight Centers:

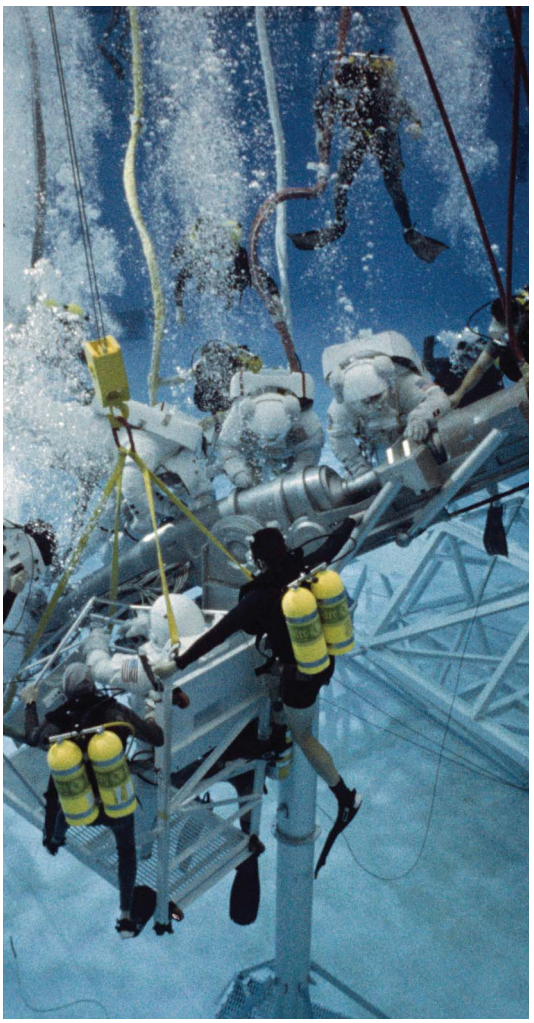
- Kennedy Space Center: space launch operations and spaceport and range technologies
- Johnson Space Center: human space flight, flight crew operations, and support of biomedical research payloads
- Marshall Space Flight Center: rocket propulsion, next-generation launch vehicles, and support of microgravity research payloads
- Stennis Space Center: rocket propulsion testing

In addition to the capabilities of the four Space Flight Centers, Space Flight Enterprise program executives acquire services and assistance from the six other NASA Field Centers. For instance, we obtain communications support from Goddard Space Flight Center. Additionally, Langley Research Center provides us with independent safety assessments through the NASA Engineering and Safety Center. See appendix 1 of this report for more details about capabilities at each of the 10 Field Centers.

Center Directors who manage the four Space Flight Centers identify and continually enhance capabilities that are not specific to any program but are essential for meeting current and future NASA requirements. This includes the following:

- Facilities and logistics management
- Laboratories and engineering services
- Safety and security
- A workforce with diverse skills
- Partnerships for the development of dual-use technologies
- Visitor centers and other innovative mechanisms for education and outreach
- Cooperative training programs with universities

Center Directors follow the guidelines contained in the NASA Facilities Engineering Functional Leadership Plan and the Agency's Real Property Strategic Plan to manage Center infrastructure safely and efficiently. We actively encourage



Enterprise Real Property

- Current replacement value: $9 billion
- Number of buildings: 1,200
- Building/office space: 24 million square feet
- Land: 223,000 acres
- Backlog of maintenance and repair: $700 million

Center Directors to display innovation in real property management while committing to the maintenance and repair of safe, high-quality facilities that are necessary for NASA programs.

Maintaining Center facilities involves minimizing redundancy, demolishing unneeded facilities, disposing of underused real property, and using competitive sourcing to explore the use of private-sector facilities. As an alternative to new construction, we encourage Centers to develop partnerships to share facilities with other Federal agencies, State and local government, and universities.

Finally, we rely on our Centers to play a leading role in promoting our corporate focus. While striving to provide excellent customer service, they will develop new methodologies that encourage cooperation among NASA Centers and programs, as well as between their respective Centers and industry, universities, and other Government agencies.

In encouraging cooperation among our Field Centers, we will ensure that:

- Every Space Flight Center has unique capabilities that contribute to Space Flight programs.
- The Space Flight Centers work cooperatively with other NASA Centers to supplement their capabilities and consolidate overlapping systems.
- Senior leaders at every Space Flight Center have experience at other Government facilities, are fundamentally inclusive, and have demonstrated a capacity to promote the ideals of One NASA and "One Space Flight Enterprise."

Through excellence in management and engineering, our Centers and programs will work in concert with each other and with all other NASA organizations. Together, we will enable future exploration and discovery, and our future will be vibrant.

Reaching for a Vibrant Future

When will our efforts end? As long as humans have a basic need to explore, the Space Flight Enterprise will strive to enhance our capabilities and extend the reach of humankind.

We are creating the foundation for a vibrant future through our commitment to space flight, a refined corporate focus, and excellence in management.

Building on our organizational strengths, we will create new capabilities for exploration in partnership with the NASA Space Architect and other NASA Enterprises. NASA's new Integrated Space Transportation Plan serves as a guideline for future developments, establishing milestones, and setting goals so that we are able to broaden our array of launch vehicles to include the Orbital Space Plane and other next-generation launch technologies. Our ongoing experiences with the Space Shuttle and expendable launch vehicles will influence the design and development of these new technologies and vehicles.

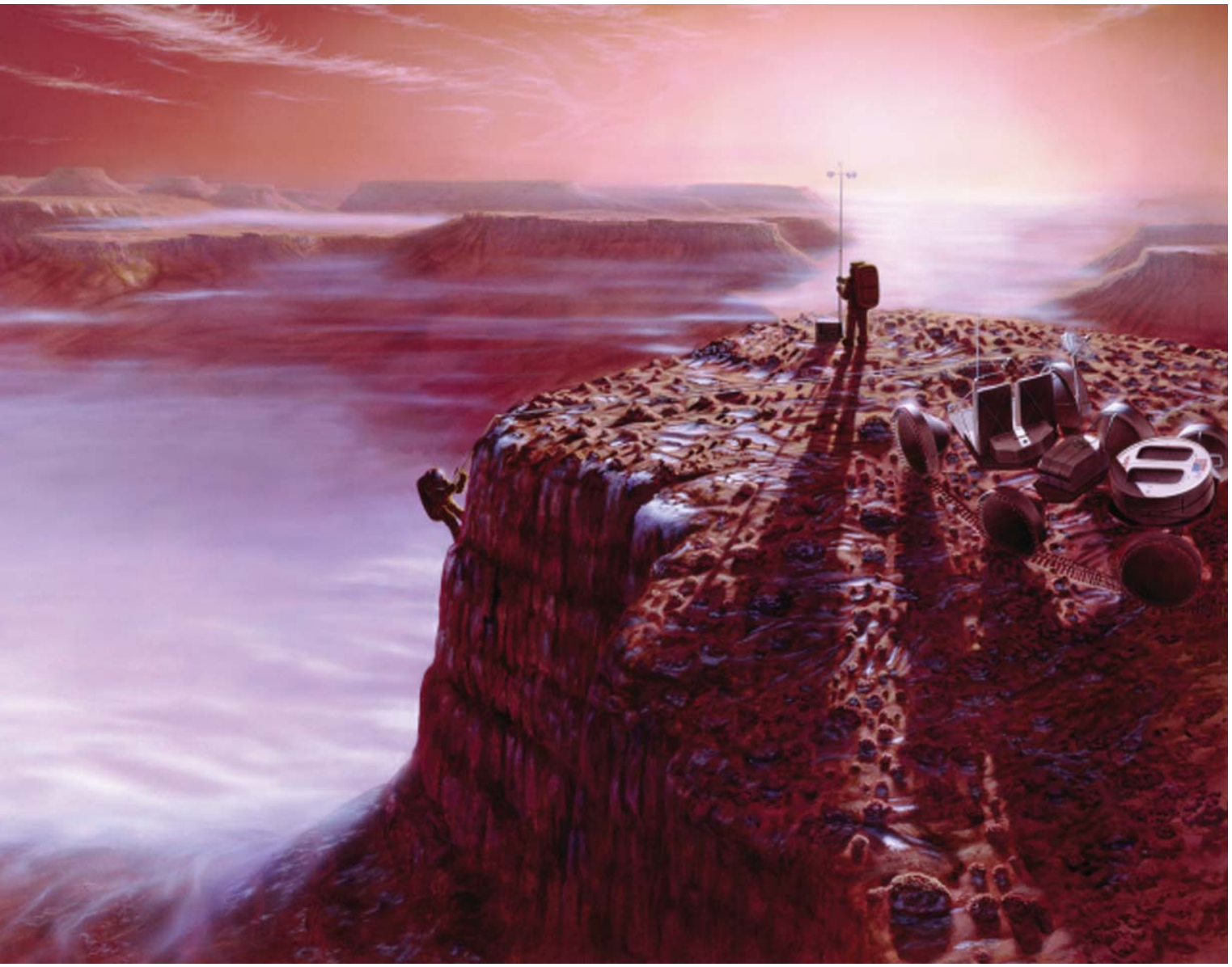
In the realm of space operations, our strategy will be to mine the capabilities of the Space Station to develop the foundation for future outposts in space. Further, we will strive to create, test, and deploy revolutionary advanced systems and innovations in space communications that can be incorporated within outposts of the future. In this way, we will serve as a catalyst for new discovery and understanding.

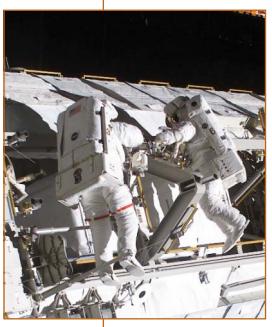
Independent of the acute needs of the moment, we will dedicate personnel and facilities to advanced, long-term developmental activity. We also will ensure that we maintain a managerial and engineering workforce skilled in developing, testing, and deploying the new capabilities that we will need in the future.

No one knows for sure what the future will bring. We cannot predict specific groundbreaking scientific or technological developments. What we are sure of is that new discoveries will occur and that they will foster exploration beyond the current space frontier. Dedication to innovation will enable us to respond quickly and capably when these new challenges and opportunities arise.

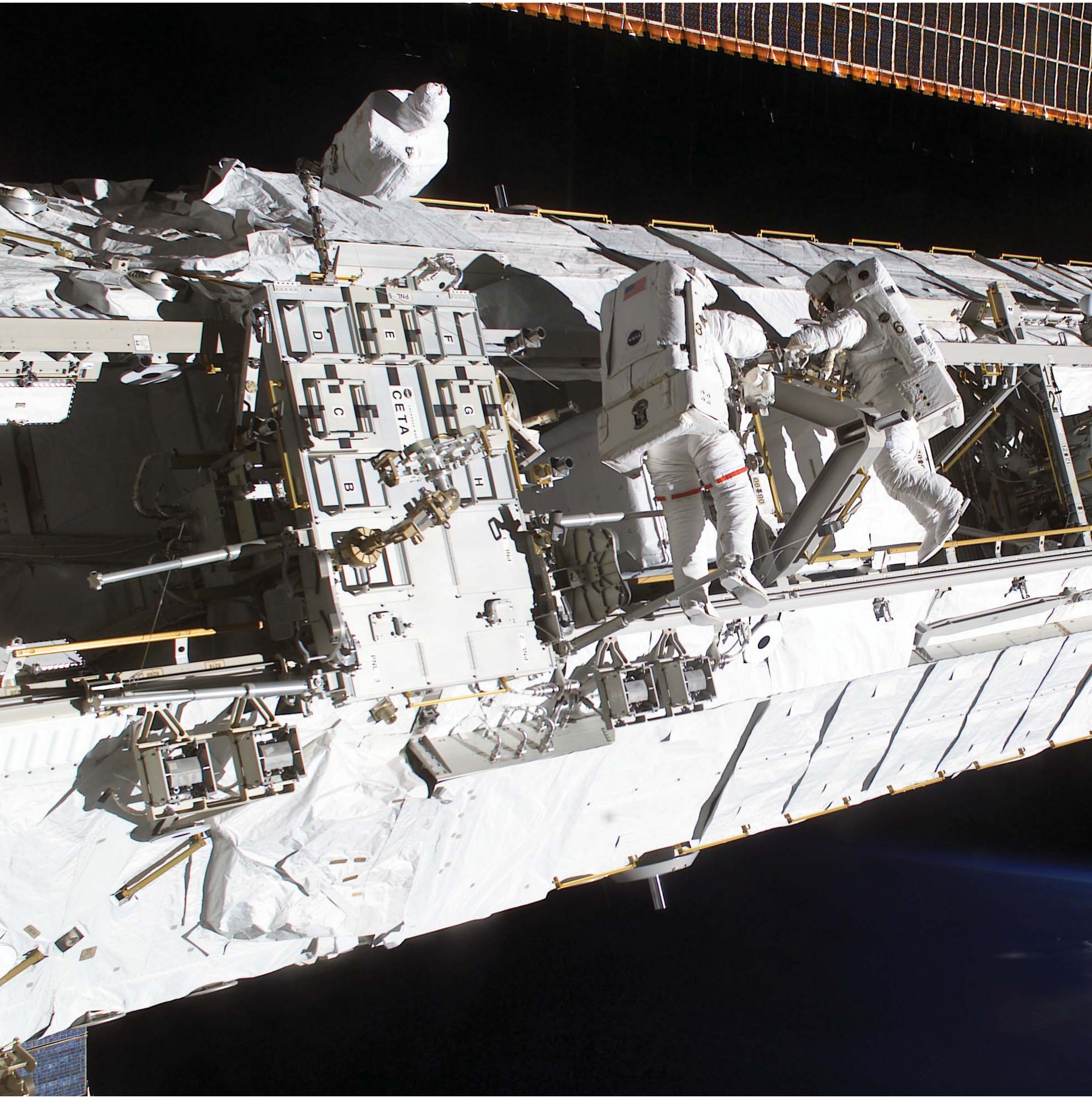
Although experience tells us that there may be great sacrifices as we forge ahead, we feel privileged to explore on behalf of all Americans.

Exploration will flourish.





3 Achieving Enterprise Objectives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3 Achieving Enterprise Objectives

The Space Flight Enterprise supports three budget themes: **International Space Station**, **Space Shuttle**, and **Space & Flight Support**. The seven programs managed by the Enterprise, including five within Space & Flight Support, are as follows:

International Space Station

Space Shuttle

Launch Services

Space Communications

Rocket Propulsion Testing

Crew Health and Safety

Advanced Systems

This section of the Strategy describes priorities and roadmaps for each Space Flight Enterprise program. It also explains how each program will address our four areas of emphasis: commitment to flight, corporate focus, management excellence, and reaching for a vibrant future.

International Space Station

The Space Station is the result of a global partnership of 16 nations. More than 40 Shuttle flights will deliver more than 100 Space Station components to orbit.

When completed, the million-pound Space Station will include more space for research than any spacecraft ever built. Internal volume will be more than the passenger-cabin volume of a 747 jumbo jet.

The Space Station accommodates public- and private-sector research in biological and physical sciences, Earth and space observations, and technology development. It also will house research that will enable human exploration of space.

For most of human history, people have learned and built within the confines of gravity. When long-range experiments are carried out on the Space Station, scientists will have an unprecedented opportunity for discovery.

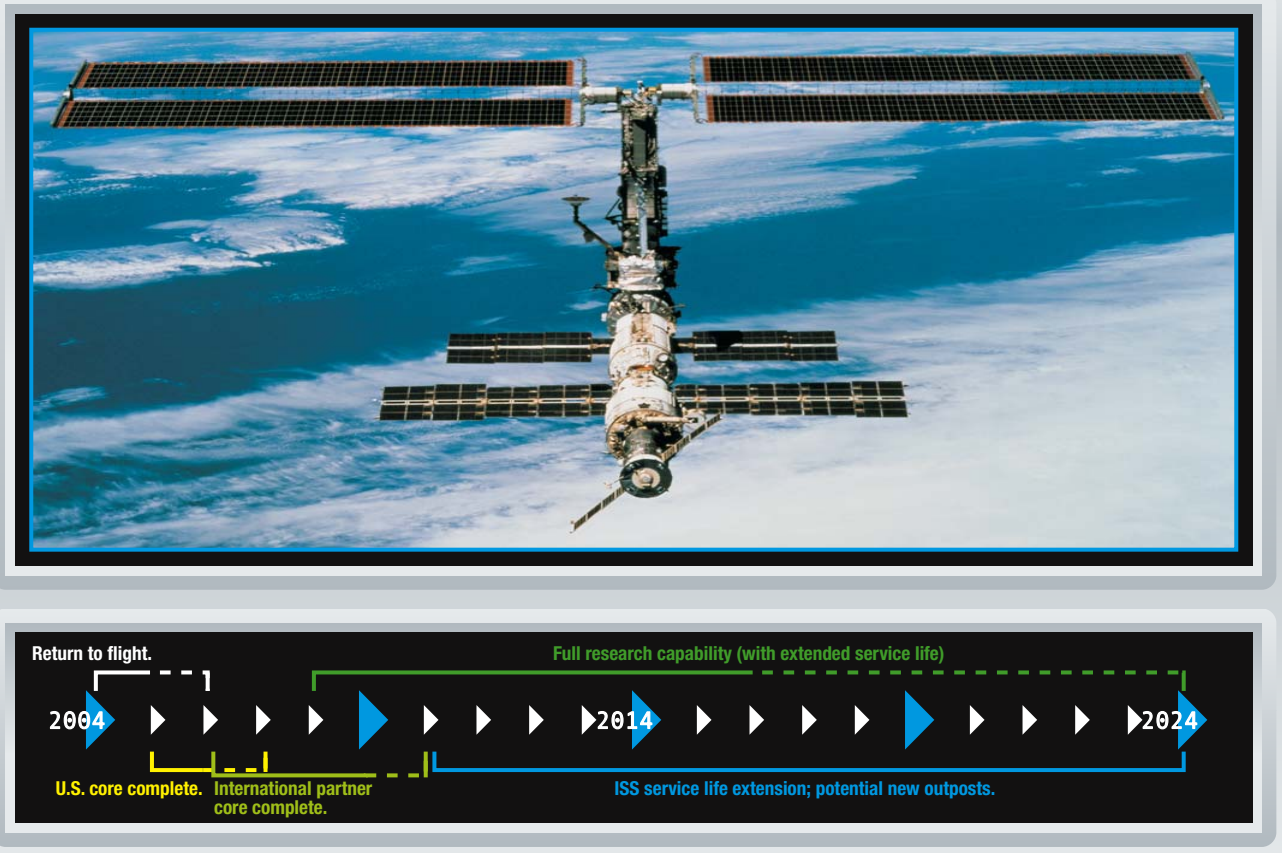
Strategic goal 8.—Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.

Strategic objective 8.4.—Assure capabilities for world-class research on a laboratory in low-Earth orbit.

Strategic goal 9.—Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.

Strategic objective 9.3.—Demonstrate the ability to support a permanent human presence in low-Earth orbit as a stepping-stone to a human presence beyond.

—From the NASA Strategic Plan



The timeline above highlights strategic priorities for the International Space Station Program over the next 20 years. Milestones are for planning purposes and depend on safety and budgetary requirements.

Commitment to Flight

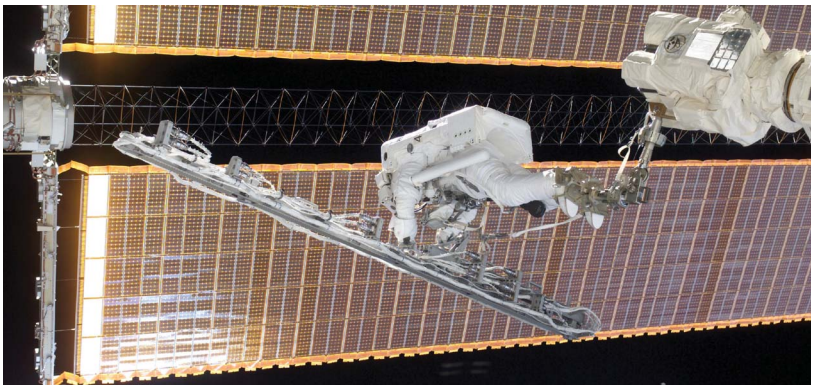
The role of the International Space Station Program is to provide the capabilities for a world-class research facility in microgravity. In all our activities, we will focus first on safety and then on other objectives.

Return to Flight

We will maintain the Space Station and perform limited research with a crew complement of two until Shuttle flights resume. The crew will rely on resupply from automated Russian Progress vehicles. Crew rotation will occur periodically, with transportation provided by Russian Soyuz vehicles. A Soyuz vehicle will always be docked with the Space Station to ensure the crew's safe return in an emergency.

International Collaboration

The Space Station constitutes the largest scientific cooperative program in history, drawing on the resources and scientific expertise of 16 nations. Members of the European Space Agency—comprising Belgium, Denmark, France, Germany, Italy, The Netherlands, Norway, Spain, Sweden, Switzerland and the United Kingdom—participate in this effort, along with Brazil, Canada, Japan, Russia and the United States.



Complete Construction To Enable Research (Years 1–5 After Return to Flight)

Construction of the Space Station makes use of an engineering approach that provides a blueprint for space construction. By building the Space Station in modular form, optimized for space launch, the International Space Station Program paves the way for future developments that have not yet been conceived.

Since construction began, we have completed about half of the Space Shuttle flights manifested for the Space Station assembly phase and delivered more than 400,000 pounds of equipment. Once Space Shuttle flights resume, modular construction of the Space Station will continue, with two significant milestones:

- **U.S. Core Complete (1–2 years after Shuttle's return to flight).**—The U.S. core configuration will provide the capabilities required to accommodate international contributions.

- **International Partner Core Complete (2–5 years after Shuttle's return to flight).**—This configuration will encompass the principal Space Station elements provided by our international partners.

Corporate Focus

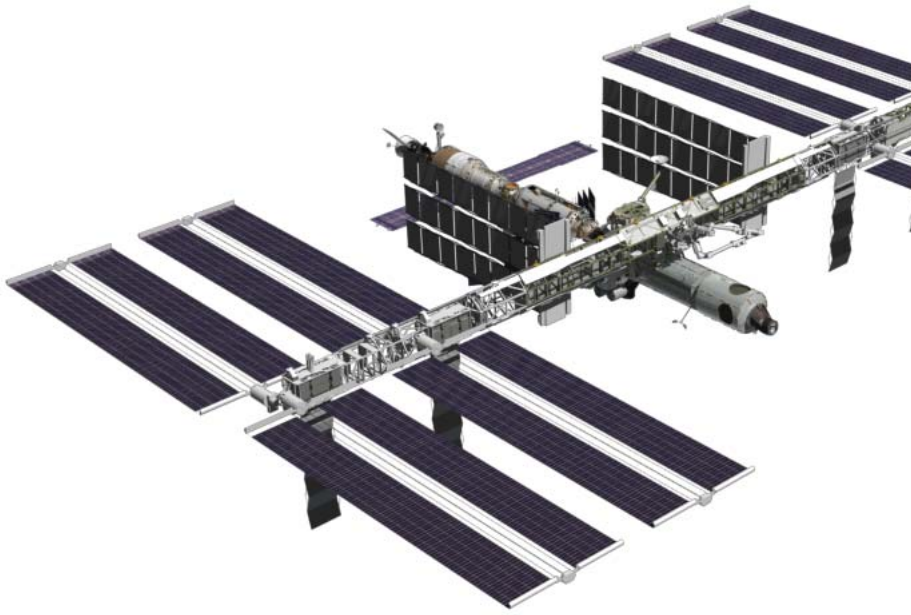
The focus of the International Space Station Program is to support research on this one-of-a-kind, space-based facility. We develop plans in close cooperation with our customers. Currently, our most frequent customer is NASA's Biological and Physical Research Enterprise. Our staffs meet regularly to reach consensus on emerging issues. We also respond to the research needs of other important customers, including NASA's Space Science and Earth Science Enterprises, industry, and other governmental organizations.

The Space Station also serves as an advanced test bed for technology development and human exploration. For example, crewmembers test autonomous medical capabilities and "smart" technologies that will be necessary to keep future astronauts safe when we extend human activity in space.

Strategic objective 8.4.—Assure capabilities for world-class research on a laboratory in low-Earth orbit.

NASA is committed to continuing the restoration of financial management control that was demonstrated in 2002 and to completing the U.S. core within available resources.

—From the NASA Strategic Plan

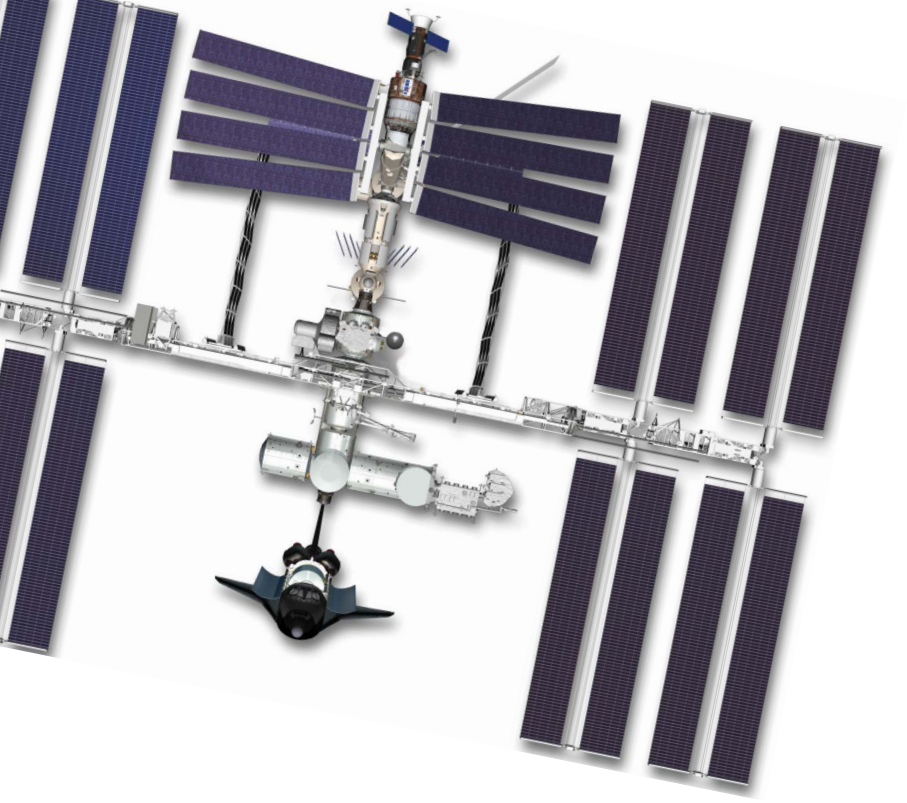


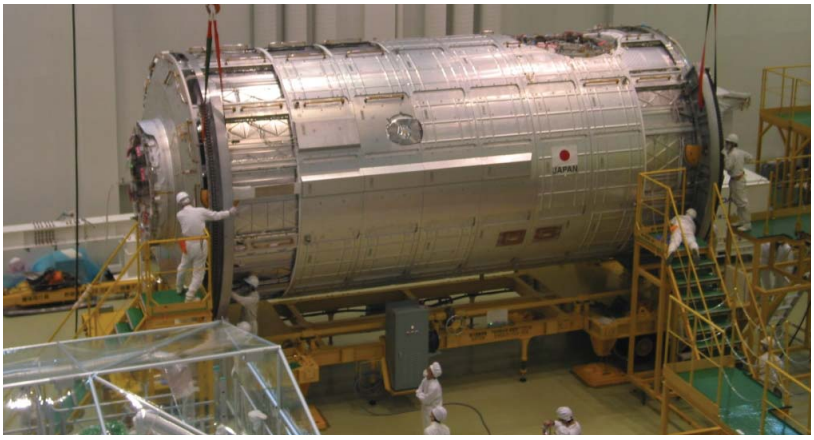
U.S. Core Complete (Years 1–2 After Return to Flight)

Within 2 years after the Shuttle returns to flight, astronauts will install the remaining U.S.-supplied elements on the Space Station. These include additional solar arrays for power; radiators for cooling; truss segments; and Node 2, which will provide pressurized living volume and connecting points for other elements provided by our international partners.

Our astronauts rely on innovations being developed through NASA's Human Research Initiative, including countermeasures designed to minimize the adverse health effects of space flight such as bone and muscle loss and long-term exposure to radiation. It is essential, therefore, to nurture a close working relationship between our astronaut corps and those responsible for NASA's Human Research Initiative.

Another area of emphasis is international cooperation. We are actively involved in coordinating bodies that discuss and resolve issues among the international partners. For example, overarching guidance for international activities on the Space Station is confirmed at "Heads of Agency" meetings. A Multilateral Coordination Board meets on a regularly scheduled basis to decide how best to implement "Heads of Agency" guidance and resolve concerns.



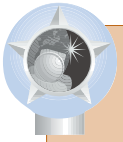


International Partner Core Complete (Years 2–5 After Return to Flight)

Once the U.S. Core Complete Configuration is achieved, astronauts will continue construction by installing modules supplied by our international partners. These modules include the following:

- European and Japanese pressurized laboratories that will house additional scientific research
- An externally exposed Japanese research facility, along with a robotic arm to facilitate research on the exposed platform
- Enhancements to the Canadian robotic arm now in use on the Space Station
- A Japanese-developed centrifuge that will greatly enhance life sciences research

In addition, unpressurized pallets will be attached externally to the Space Station to facilitate engineering technology development as well as Earth and space observational research.



Management Excellence

Working with our international partners, we are setting clear objectives, with safety as the first priority. One such effort is defining a credible end state that delineates a core complete configuration for U.S. and international contributions. We will manage based on objectives, schedule, and budget. By implementing an integrated management information system and relying upon full-cost accounting principles, we are streamlining management reporting and control at the program level. Schedule, staffing, and critical facility decisions are made on an integrated basis at the highest level. We will consolidate prime and nonprime contracts into a minimum number to manage them effectively at the program level.

We will manage our resources to maximize the research potential on the Space Station. The needs of NASA's science programs are being effectively integrated into the Space Station's management process so that research remains a core objective. To that end, we will strive to optimize the crew size in the near and long terms. We will aggregate and analyze program reserves at the highest organizational level so that we can respond flexibly to the

Strategic objective 9.3.—Demonstrate the ability to support a permanent human presence in low-Earth orbit as a stepping-stone to a human presence beyond.

One of the most important aspects of the Space Station, in addition to the scientific and technological innovations that it supports, is that it provides invaluable experience in actually working and living in space. Our astronauts and ground controllers help teach us how to eat and sleep, how to live for months at a time in orbit, and what to expect upon return to Earth. Our success in managing and operating the Space Station will tell us when we are ready to take the next steps into the solar system. Extending the boundaries of human space flight requires knowledge of the space environment, the effects of living and working there, and the development of countermeasures to maintain crew safety, health, and efficiency. It also requires that we determine the best mix of humans and machines for various tasks to take advantage of the unique capabilities of both. Through the Space Station, NASA is developing a large body of knowledge on the practical aspects of human activities in space.

—From the NASA Strategic Plan

Full Research Capability (Years 4–12+)

The completed Space Station is designed to support robust research through at least 2016 and perhaps much longer if its service life is extended. During this period, the priority will be to support full-scale scientific and engineering research.

To maximize research, we will optimize crew size. Crew size will be determined by the availability of emergency crew-return vehicles.

In coordination with our partners, we will analyze requirements and resources and decide whether to provide an additional docking node on the Space Station and a regenerative Environmental Control and Life Support System. We will explore additional ways to enhance Space Station research. For example, we

high-priority needs of our research customers. We will continuously improve process efficiencies for manifesting, integrating, and operating research investigations and experiments, and we will develop common requirements that will reduce the documentation and resources needed for payload integration.

Over time, we will refocus Space Station management to emphasize sustainability rather than construction. By testing and learning, we will improve the efficiency of on-orbit systems maintenance and operation, provide alternative capabilities for critical functions, and create a safer and more productive working environment for Space Station crewmembers. We will also seriously evaluate alternatives to Government management of the program. For example, first steps in transitioning certain management responsibilities to a nongovernmental entity may involve creating a Space Station research institute dedicated to facilitating the research community's use of the on-orbit research laboratory. We also will seek to identify new ways to enable NASA's research, educational, and outreach goals and to protect our home planet through strategic alliances, partnerships, and collaborations with academia, industry, and other Government agencies.

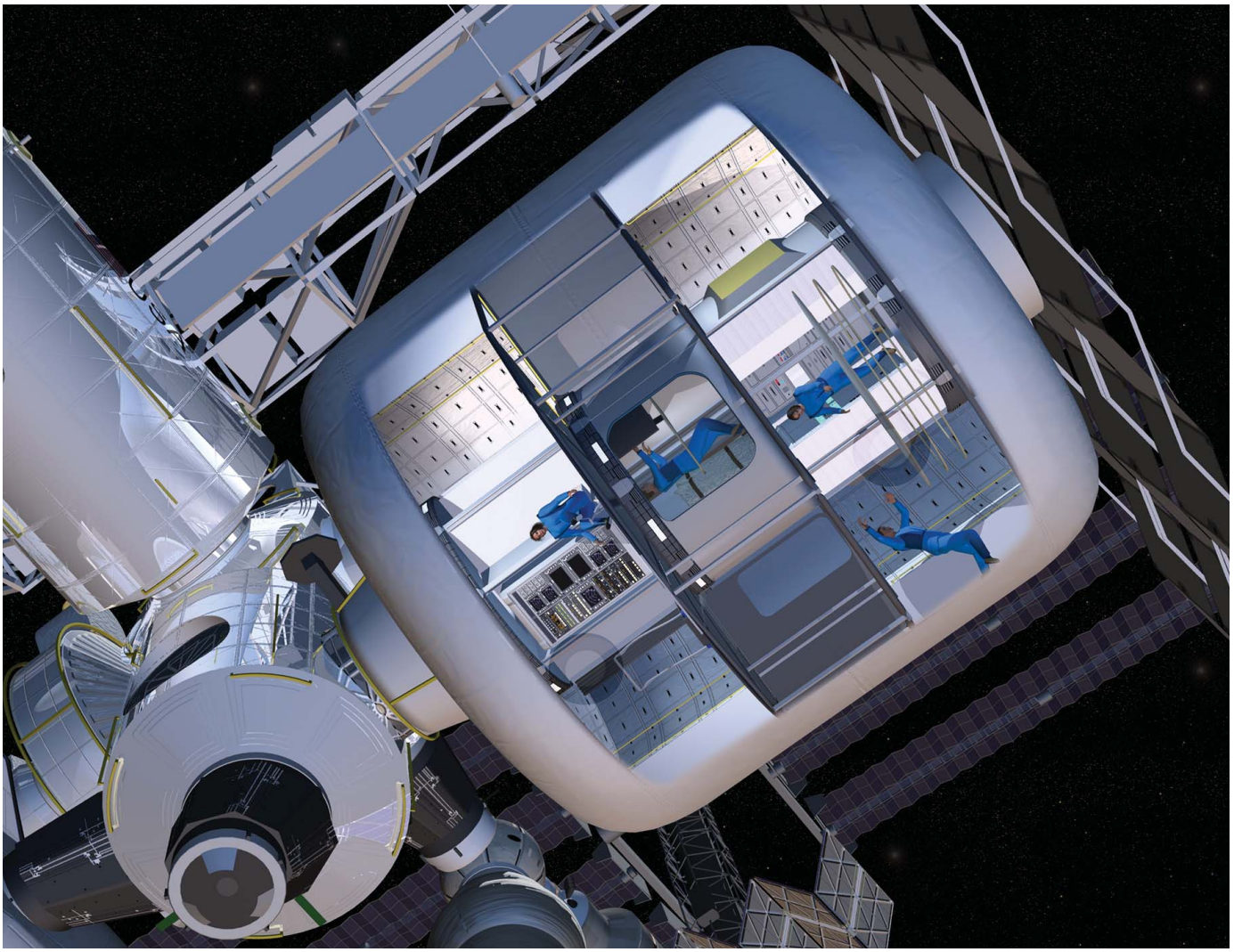
will analyze whether the Shuttles can be modified to provide extended Space Station stays. If so, the Shuttle would be able to provide additional capacity for research while docked with the Space Station. By working with our partners, we will determine how to optimize cargo transportation and resupply operations. We will evaluate proposals for new ways to use the Shuttle, and incorporate plans by the Europeans and Japanese to provide autonomous cargo vehicles. Additionally, we will examine our ongoing reliance on Russian Progress vehicles and evaluate potential commercial sources of transportation.

Reaching for a Vibrant Future

During the assembly of the Space Station, we demonstrated new techniques for developing modular space structures, providing NASA with a blueprint for designing and building future space systems. Much as the Gemini program laid the groundwork for the Apollo spacecraft's historic flight to the moon, we will use the Space Station to learn how to overcome human limitations in space and create a springboard for future exploration beyond Earth's orbit.

Service Life Extension and Potential New Outposts (Years 6–20)

After achieving the Space Station's full research potential and before it reaches the end of its design life, we will work with our international partners and NASA's Biological and Physical Research Enterprise to determine whether to extend the Space Station's service life. If a decision is made to extend service life, we will identify decaying or outdated infrastructure and make the necessary repairs to sustain and enhance performance. This will be accomplished by implementing an inclusive process similar to the Space Shuttle Service Life Extension Program. Depending on science requirements, we may also assemble and deploy new outposts in space to enhance human and robotic exploration.



Space Shuttle

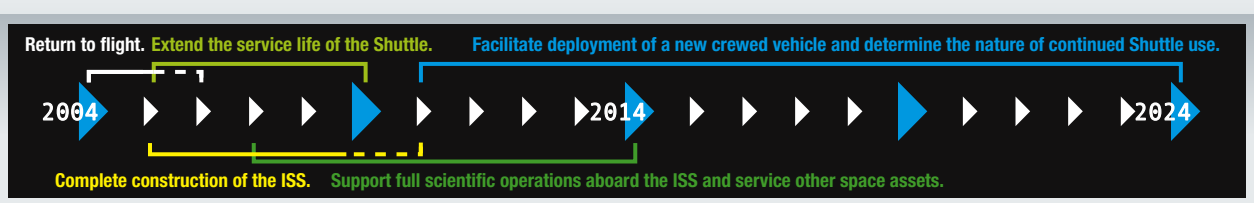
The Space Shuttle has served as a workhorse for the United States space program for more than 20 years. The Shuttle of today, however, has evolved significantly beyond the Shuttle of yesterday. Although it may look the same on the exterior, it has undergone continuous technological improvement. We will now be making additional safety enhancements to the Shuttle system so that the Shuttle fleet can better support scientific research and fulfill the potential of the International Space Station.

Strategic goal 8.—Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.

Strategic objective 8.3.—Improve the accessibility of space to better meet research, Space Station assembly, and operations requirements.

NASA will pursue a service-life extension for the Shuttle to improve safety, reliability, and maintainability. NASA also will work to effect a smooth transition from the Space Shuttle to the next-generation systems at the appropriate time.

—From the NASA Strategic Plan



The timeline above highlights strategic priorities for the Space Shuttle Program over the next 20 years. Milestones are for planning purposes and depend on safety and budgetary requirements.

Commitment to Flight

Before resuming Shuttle flights, we will comply with recommendations from the Columbia Accident Investigation Board and take additional steps to enhance flight safety. Once Shuttle flights resume, the priority for the Space Shuttle Program will be to launch the elements necessary to complete the International Space Station.

Return to Flight

We will implement essential safety, hardware, and process modifications so that Shuttle flights can resume.

The culture we create will encourage open discussion of potential safety issues. We will enhance the processes we use to identify, manage, and mitigate risk, and we will review our systems and processes to maintain and enhance critical safety checks and balances.

Specifics are described in NASA's Implementation Plan for the Return to Flight and Beyond. The Implementation Plan is available to the public through the internet at *www.nasa.gov*, and it will be updated regularly.

Complete Construction of the International Space Station (Years 1–5 After Return to Flight)

Space Shuttle flights will be manifested based on safety requirements and customer priorities. When the Shuttle fleet returns to flight, the overarching priority will be to safely complete the U.S. and International Core Complete phase of Space Station construction so that we may enable new science as soon as possible.

During the assembly phase, the Shuttle will be used primarily to lift new Station elements into orbit and to meet ongoing Station logistics, resupply, and research requirements.

"All great and honorable actions are accompanied with great difficulties, and both must be enterprised and overcome with answerable courage."

—President John F. Kennedy, September 12, 1962

Corporate Focus

The focus of the Space Shuttle Program is to provide human access to and cargo and logistics support for the International Space Station Program. Our customer's priority is to make the Space Station able to function as a world-class research facility. Accordingly, the priority for the Shuttle Program is to resume safe Shuttle flights and complete construction of the Space Station as soon as is practicable. We achieve our space flight objectives by relying on our four Space Flight Centers and industry, and by working cooperatively with other NASA organizations.

We are commited to promoting safety while pursuing space flight. We will work closely with NASA's Office of Safety and Mission Assurance and NASA's Safety and Engineering Center to implement safe activities in all of our operations. We continue to participate actively in a Shuttle Program Contractor Safety Council, a forum in which senior safety managers from all of our major contractors share lessons learned and best practices and partner with NASA managers to improve safety performance. Together, we will promote a culture that encourages open discussion about safety concerns at all levels and among all participating organizations.

We will strive to promote efficiency among the components of the Space Shuttle Program. To do so, the Shuttle Program will operate in a business relationship with the four Space Flight Centers by acquiring required services from each Center. As another method to promote effective interrelationships, the Shuttle Program is being designed to ensure that there is substantial participation from leaders at all Centers and from industry.

Support Full Scientific Operations Aboard the Space Station and Service Other Space Assets (Years 3–10)

As construction nears completion, the Shuttle will be used primarily to support scientific operations on the Space Station, including support for an expanded crew complement. This will involve ground support for the Shuttle system and the transportation of crew, cargo, and research experiments to and from the Space Station.

As safety, manifesting, and budgetary constraints permit, the Shuttle also will be used to advance other scientific, technical, or public policy needs. For example, the Shuttle will enable the crew to maintain and repair the Hubble Space Telescope.

To improve our response to customer needs, we will enhance our flight design process so that the final payload configuration of a Shuttle mission can be deferred to closer to the launch date. This will provide more flexibility so that we can better adapt the flight manifest to fit customer needs. The Space Flight Enterprise Launch Services Program provides customer support and liaison activity for payload manifesting on Shuttle flights. The Shuttle Program will work closely with Launch Services to ensure that the Shuttle Program is responding well to the needs of our customers.

The Space Shuttle Program also collaborates with NASA's Education Enterprise and NASA's Biological and Physical Research Enterprise to educate and inspire future generations of scientists, engineers, mathematicians, and explorers. For example, the Educator Astronaut Program will enable teachers to provide a connection between space and the classroom. Our astronauts, engineers, and scientists will regularly participate in education outreach programs. We also will continue to engage students in live, interactive programs with orbiting crews.

Finally, the future of human space flight depends on new vehicles and new technologies being developed by NASA's Aerospace Technology Enterprise. We will assign liaisons to work closely with that Enterprise to share expertise and ensure a smooth transition from new vehicle development to in-flight operations.

Panels Within the Service Life Extension Program

Safety.—Identify, evaluate, and prioritize proposals that can improve flight safety. Assess technical merit, cost, schedule, risk and maturity, and propose strategies that optimize safety and cost. Assess industrial safety.

Sustainability.—Ensure that the capabilities of the Shuttle do not erode. This includes maintaining flight and ground logistics needs, obsolescence, supplier viability, process control, special test devices, project-unique tooling, and lab equipment.

Infrastructure.—Ensure that infrastructure is in place to support the Shuttle. This includes facility construction and maintenance, facility support systems, ground support equipment, generic tooling capability, and production support equipment.

Industry.—Provide a consolidated view of existing industrial capability. Identify skills and resources critical to long-term support of human space flight. Identify potential technological advances, and operational improvements. Find potential areas for cost reduction through efficiency, innovation, and/or consolidation of capabilities.

Technology.—Review technological capabilities identified by industry, academia, and NASA research. Catalog technologies having the potential to improve the service life of the Shuttle and define the technology readiness level (TRL). Assess how the Shuttle can be a technology demonstration platform for required next generation systems.

Strategy.—Assess emerging requirements to Service Life Extension Program (SLEP) based on the NASA Strategic Plan, the Integrated Space Transportation Plan, and the needs of the Shuttle customer community, including the Space Station. Develop and review proposals for operational improvements, increased performance, or enhanced responsiveness to customer needs.

Transition (Return to Flight).—Assess the full range of return-to-flight recommendations and identify all "carry-over" items that will not be closed with the first re-flight. Ensure issues that should be assessed within SLEP are reviewed by the appropriate SLEP panels.

Integration.—Define requirements and guidelines that the other panels will use to develop their recommendations. Validate project resource estimates provided by the panels. Integrate the prioritized panel recommendations to develop an overall SLEP content and funding profile.

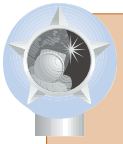
Develop plans to extend the service life of the Shuttle (Years 1–5)

We also will evaluate proposals for long-term Shuttle Program modifications. Our aim is to substantially complete that analysis during the Space Station's construction phase so that we can make improvements shortly thereafter. Modifications to the orbiters will be made during regularly scheduled overhauls.

To analyze these long-term investment choices, we will rely on a strategic and proactive initiative, the Space Shuttle Service Life Extension Program. Through an inclusive process that includes all stakeholders, we will prioritize and manage these investments to enable safe, affordable, and efficient Shuttle flight into the next decade.

Through the Service Life Extension Program, we will endeavor to do the following:

- Enhance systems and tools that track and mitigate flight risk
- Replace existing Shuttle components that will not reliably extend Shuttle flight
- Invest in research and development infrastructure to ensure safe operations for Shuttle ground-support equipment, as well as tooling and special test equipment required for Shuttle processing



Management Excellence

To streamline management processes, we combined our Shuttle and International Space Station Programs, led by a Deputy Associate Administrator. With safety as the first priority, we will develop schedules that optimize goals common to both programs. Management reserves will be aggregated and analyzed at the highest organizational level. Enhanced communication about priorities among all members of the program team—including NASA employees, contractors, and suppliers—will also facilitate overall alignment with common goals. Along with strategic communication through inclusive meetings and symposia, we will develop and rely upon an integrated management information system as a single, authoritative source for common information about all aspects of both programs.

Full-cost accounting provides an important fiscal tool that will enable us to better evaluate expenditures. We will enhance efficiency by consolidating facilities and eliminating unnecessary ones.

Because process control is an essential element of safe and efficient operations, we will enhance our process-engineering reviews and use focus groups to enhance awareness of process issues among our contractors and suppliers. We also will use state-of-the-art industrial engineering analysis, including computer-aided modeling

Implementing Strategy

We will enhance our core engineering, management, and scientific capabilities and processes to ensure safety and mission success, increase performance, and reduce cost.

—From the NASA Strategic Plan

- Restore, modify, and replace facilities to improve performance, address environmental concerns, and ensure the facilities' readiness to support the Shuttle system

Currently, Shuttle flights are limited in duration, primarily because of constraints on the Shuttle's Environmental Control and Life Support System. Along with extending the service life of the Shuttle, we will use the Service Life Extension Program and customer requirements to evaluate whether to invest in the modifications necessary for extending the duration of Shuttle flights.

and simulation, to review and identify cost and safety improvements efficiently and proactively in the design of our facilities and the way our people operate within them.

Currently, more than 90 percent of Space Shuttle Program funding is directed externally to a network of contractors. We will continue to rely on contractor support and incorporate insights gained from the Columbia Accident Investigation Board into our planning processes. We will pursue the path that best promotes effective oversight and safety of flight while also promoting fiscal efficiency.

Excellent management of the Space Shuttle Program also requires a forward-looking investment in human capital. This is particularly important as we strive to extend the service life of the Shuttle fleet. To provide our employees with new critical skills, we will enhance training programs based on lessons learned from our ongoing Shuttle operations. We also will hire employees who fill current or anticipated gaps in workforce skills. To attract new engineers, we will enter into innovative partnerships with universities to develop curricula and onsite training so that "work-ready" graduates can readily support the Shuttle and other space-based programs.

Reaching for a Vibrant Future

In pursuit of scientific gains from NASA's space assets, the Space Shuttle represents an essential resource. In the future, the Space Shuttle Program will continue to provide access to space with enhanced capability for risk management and heightened safety consciousness.

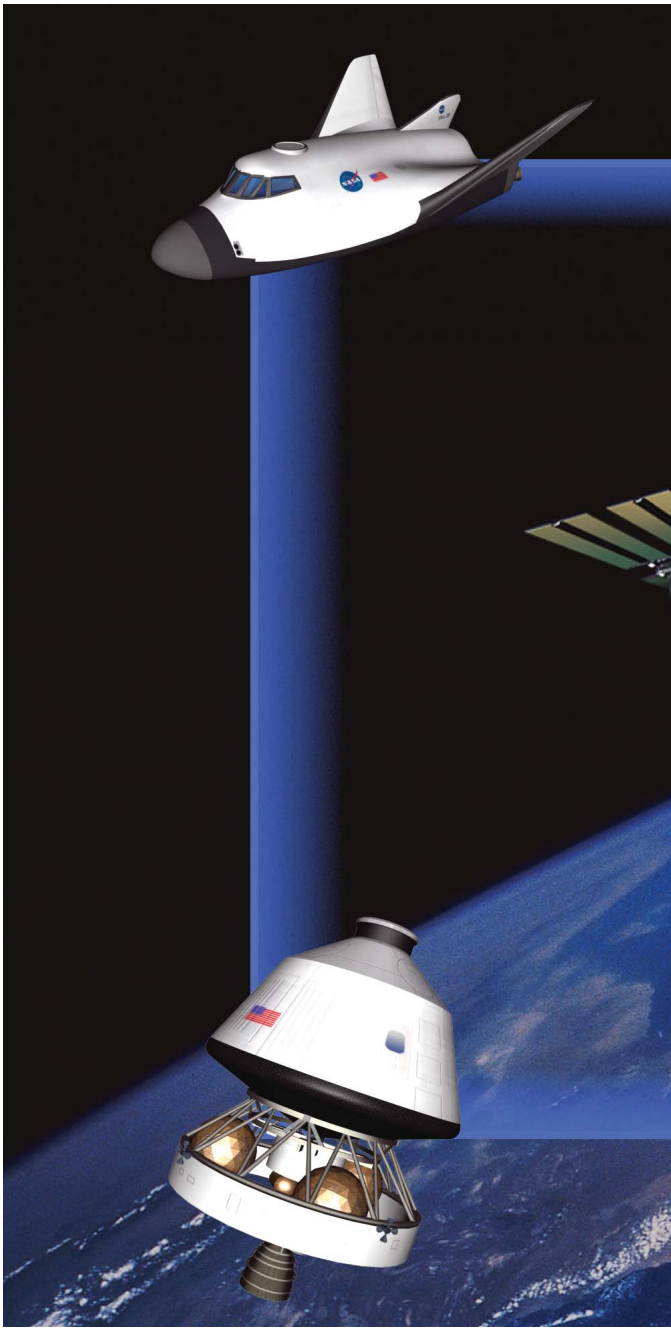
The Space Shuttle is a stepping-stone toward future human space flight. The Space Shuttle Program will evolve with the demands of its customer base and thereby enable a smooth transition to new crewed vehicles.

Facilitate Deployment of a New Crewed Vehicle and Determine the Nature of Continued Shuttle Use (Years 6–20)

NASA's Strategic Plan and Integrated Space Transportation Plan call for the development of an Orbital Space Plane for human space flight that will use evolved expendable launch vehicles (EELVs). This includes certifying the Space Plane and EELV systems for human use. NASA plans to establish this new capability for Space Station crew return as soon as practicable but no later than 2010 and for crew transfer no later than 2012. Based on the development of the Space Plane, we will decide either to continue flying the Space Shuttle through 2020 or to rely on the Space Plane and EELVs for crew transportation to and from the Station. We also may use the Space Shuttle to supplement the Space Plane by transporting crew or transferring cargo, perhaps autonomously.

Development of the Orbital Space Plane is the responsibility of NASA's Aerospace Technology Enterprise. When the new Space Plane becomes ready for space flight, responsibility will be transferred to the Space Flight Enterprise.

The Space Flight Enterprise will work closely with our counterparts in the Aerospace Technology Enterprise to promote a smooth transition from development to space flight. We are contributing to conceptual planning, design, development, and future in-space operations. For example, we participate in task forces and share expertise concerning assent and re-entry, failure tolerance, flight control management, and human safety requirements.




United States


NASA
DISCOVERY
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Launch Services

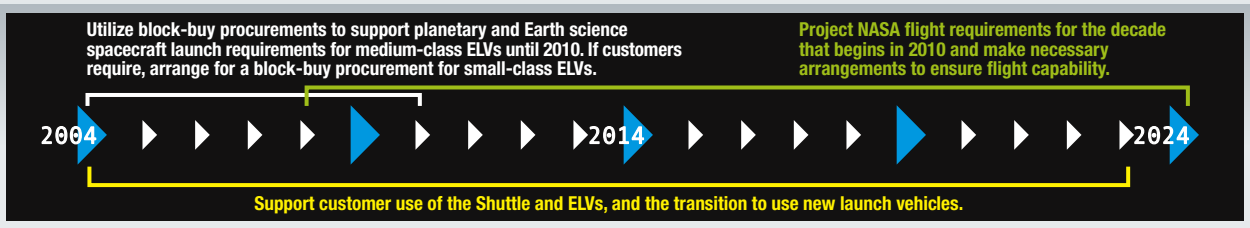
Space mission success depends on reliable, cost-effective, and timely access to space. The Launch Services Program serves as the Space Flight Enterprise's customer interface for ensuring access to space on all available launch systems. These include the Space Shuttle, commercial and DOD launch vehicles, and foreign launch systems. Launch Services provides customer support for space access to all NASA Enterprises and other Government agencies, such as the National Oceanic and Atmospheric Administration.

NASA relies on commercial launch vehicles, which historically have been expendable launch vehicles, to ensure access for the majority of space and Earth science missions that do not require the Shuttle's unique capabilities. For all space and Earth science missions, the program identifies launch requirements and arranges for the delivery of science payloads to their desired orbit. We provide the specialized support required for preparing payloads, relying on a mixture of Government-owned and commercial facilities.

Strategic goal 8.—Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.

Strategic objective 8.5.—Provide services for . . . launch in support of NASA, other Government agencies, and industry.

—From the NASA Strategic Plan



The timeline above highlights strategic priorities for the Launch Services Program over the next 20 years. Milestones are for planning purposes and depend on safety and budgetary requirements.

Consistent with NASA policy, the Shuttle is used to launch primary payloads that require human support and transportation to and from the Space Station. On an "as-available" basis, secondary payloads may be accommodated within the Shuttle cargo bay. Launch Services works with Space Flight Enterprise customers to determine when the special capabilities of the Shuttle might be available to support a payload mission. We provide facilities, capabilities, and technical expertise for payload assembly; test and checkout; servicing of multiple payloads; and integration and installation into the Shuttle prior to launch. Launch Services also manages the use of carrier systems and pallets designed to accommodate experiments and payloads in the Shuttle's cargo bay that support education, science, technology, and military requirements. This capability supports large observatories, such as the Hubble Space Telescope, as well as small, self-contained canisters flown as tertiary payloads.

Corporate Focus

The Launch Services Program serves as the Space Flight Enterprise's customer liaison office for access to space. Its focus is to meet all launch requirements for NASA's science and technology organizations.

Thorough and effective customer service is essential. On behalf of our customers, we provide technical oversight in all phases of launch activity to maximize the probability of mission success. While a space mission is being developed, we share knowledge about launch capabilities to aid spacecraft design. As the launch date nears, we provide assistance to optimize the integration of the spacecraft within the launch vehicle; on the day of launch, we coordinate launch and range activities on behalf of our customers.

Another priority is understanding the near-, mid-, and long-term needs of our customers. We regularly discuss NASA's launch requirements and plans to meet these requirements at a myriad of public- and Government-sponsored

Commitment to Flight

NASA's space and Earth science missions primarily use expendable launch vehicles. We will continue to rely on these vehicles and provide oversight to promote flight safety. Flight support for research on the Space Station will resume as soon as is practicable.

We rely on a mixed fleet of launch vehicles so that, despite an interruption in Shuttle flights, we can continue to fly high-priority science missions, such as the Space Infrared Telescope Facility and missions to Mars. NASA will continue to rely on ELVs to launch the majority of Earth-observing and space science satellites, including missions to comets and asteroids, as well as to Europa and Pluto. The robust launch schedule for ELV-based science missions is not affected by the review of the Columbia accident.

When Shuttle flights resume, Shuttle transportation will primarily service the Space Station; non-Space Station use of the Space Shuttle will be considered on a case-by-case basis. As the capability of the Space Station to support research activity increases, Shuttle carrier support activities that are not intended for the Space Station will be evaluated to determine whether they should be retained or retired.

forums with other Government users and industry. Once customer requirements become clear, we work closely with the commercial sector and other Government agencies to ensure the capability and availability for the required service. We also share NASA's requirements on a periodic basis with the DOD for inclusion in a National Mission Model, which serves as a Governmentwide, long-range planning tool for space launch.

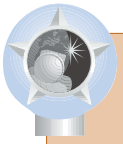
To coordinate among NASA organizations, we chair a Flight Planning Board that includes the senior membership from each NASA Enterprise. The Flight Planning Board meets at least quarterly to identify conflicts in ensuring space access and to forge solutions. The Flight Planning Board works in tandem with a Space Station Utilization Board, chaired by NASA's Chief Scientist, to decide priorities for research equipment and experiments to be manifested on Shuttle launches to the Space Station.

Evolution of Flight Priorities for Ensured Space Access

We rely on our customers to define their future space access mission requirements. Maximizing the use of the Space Station will be the priority for Shuttle flights after NASA completes the Space Station's construction. We will work with our customers to develop manifesting options that give priority to Space Station-based scientific research and provide the capacity to properly operate and maintain the Space Shuttle and Space Station. We also will assess options to use domestic launch services to augment space access for Space Station cargo and crew requirements.

As resources permit, the Shuttle also will support NASA's education objectives, DOD requirements, and NASA space and Earth science missions that do not involve the Space Station. Consistent with full-cost accounting objectives, we are developing a Shuttle pricing policy for NASA-sponsored payloads. This policy will be based on the value of a Shuttle launch opportunity. Our aim is to update and refine our manifesting and pricing policy for Shuttle use on an ongoing basis.

NASA will continue to rely on commercial launch vehicles as a primary mode of space access. An essential challenge will be to negotiate the requirements of our diverse customer base with dynamic market conditions as we demonstrate new launch systems and retire heritage systems. An essential component of our strategy is to ensure that a sufficient and reliable industrial capacity continues to be available to meet NASA's future flight objectives. To this end, we will continue to work closely with the National Reconnaissance Office and the U.S. Air Force to nurture the U.S. industrial base. Because many NASA science payloads require small-class (such as Pegasus) and medium-class (such as Delta II) launch capabilities, we will continue to aggregate payloads of this size and purchase blocks of launch services.



Management Excellence

Because Launch Services acts as the principal liaison between the Space Flight Enterprise and other organizations that rely on us for access to space, we must strive for continuous improvement in customer support. We conduct customer forums to regularly evaluate and implement improvements in launch services support for our customers. We also will review our human capital requirements to ensure that our workforce is robust and well trained in all aspects of the required technical capabilities as well as customer support.

To ensure fiscal efficiency and a quality product, we rely on competitive sourcing to identify launch-vehicle providers that offer quality services at fair prices. We will use the Shuttle only when a commercial launch provider cannot meet our requirements. Although current policy dictates that we rely on U.S. commercial launch companies, we will evaluate international providers to maintain the ability to meet any unusual customer requirements that cannot be adequately provided by domestically available sources.

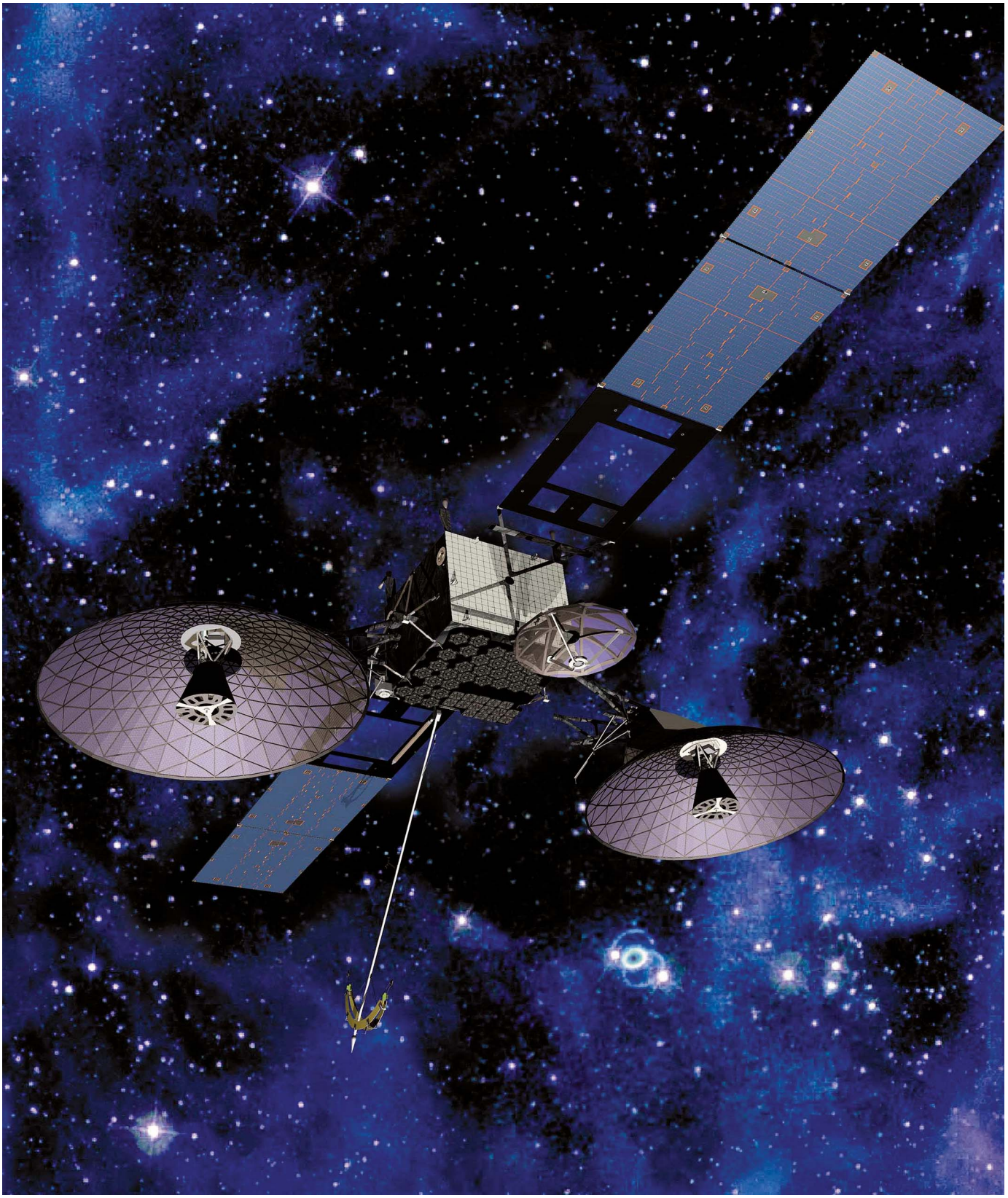
For payload processing, NASA will continue to provide those services that must be uniquely provided by the Government. For example, planetary payloads require extra cleanliness and nuclear payloads need additional safety provisions that are best met at Government facilities. Payload processing that does not require capabilities unique to the Government will be obtained from commercial vendors. Before launch service work is initiated, we ensure

Reaching for a Vibrant Future
A portfolio of existing and new launch vehicles will be used to meet future NASA requirements. This will include using a heavy-lift vehicle, such as an evolved expendable launch vehicle for future human space flight.

NASA will continue to rely on a mixed fleet of launch vehicles for future space transportation. This fleet encompasses all commercial launch vehicles, the Space Shuttle, and launch systems provided by NASA's international partners. It also includes plans for new systems such as the Orbital Space Plane, emerging domestic launch services, and a transition to next-generation launch technologies. We are now developing investment plans that would allow us to use commercial launch vehicles through at least 2015. In the midterm, however, NASA expects to use the larger-capacity Delta IV and Atlas V systems for large space science missions and advanced-technology demonstrators, such as the X-37 and the Orbital Space Plane. NASA's Integrated Space Transportation Plan will reflect the Agency's launch requirements and investment strategies for expendable and reusable systems under development.

that all launch contracts satisfy technical requirements and are adequately funded, well understood by all parties, and properly documented. We will continue to promote economy and efficiency in our operations through the purchase of blocks of launch services. Block buys enable the Space Flight Enterprise to ensure space access within a fixed budget.

With the advent of full-cost accounting, it is necessary to clearly delineate the elements of cost associated with providing launch services. For this purpose, we develop, coordinate, and implement pricing policies associated with Shuttle and ELV launch services. This is done to ensure that funding is adequately and properly accounted for within the budget for each NASA mission. All launch service contracts are firm, fixed-price awards and are tied to customer requirements. We will continue to enhance the safety and success of NASA missions on ELVs. We provide technical oversight and new-vehicle certification, which have contributed to our goal of 95 percent or greater demonstrated launch success for NASA missions. This is accomplished through comprehensive, well-documented technical oversight and approval of commercial services, from contract award through final approval for launch. Launch-vehicle preparation and launch-site processing are assessed through a set of formal status reviews. This formal process culminates with a Launch Readiness Review, held 1 to 2 days before launch, at which time the Certificate of Flight Readiness is signed by all principals involved in the launch.



Space Communications

Capable and dependable communications are vital for the success of all human and robotic space missions. Mission controllers, astronauts, and scientists depend on communications networks so that they can monitor spacecraft, intercede when problems arise, and share technical and scientific data.

The Space Flight Enterprise's Space Communications Program integrates Agencywide telecommunications issues that influence policy formulation as well as the development and operation of NASA's space communications architecture. This architecture includes multiple radio communications networks and interconnected telecommunications capabilities that support operations in near-Earth orbit and deep space.

Strategic goal 8.—Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.

Strategic objective 8.5.—Provide services for space communications . . . in support of NASA, other Government agencies, and industry.

—From the NASA Strategic Plan

The timeline above highlights strategic priorities for the Space Communications Program over the next 20 years. Milestones are for planning purposes and depend on safety and budgetary requirements.

The Space Communications Program also is primarily responsible for managing two communications networks that enable space flight operations and research: the Space Network and the NASA Integrated Services Network (NISN).

The Space Network is composed of space and ground segments that provide tracking and data relay services for a variety of customers, both internal and external to NASA. The space segment consists of the Tracking and Data Relay Satellite (TDRS) system, a constellation of five operational communications satellites in geosynchronous orbit. The ground segment consists of space-to-ground link terminals and supporting facilities located at the White Sands Complex in New Mexico, the Guam Remote Ground Terminal, and other sites.

The NISN provides wide area network telecommunications services for transmitting mission and administrative data, video, and voice for all NASA Enterprises and Centers. It relies on commercial telecommunications capabilities. Specific services include real-time, mission-critical data and voice distribution; video teleconferencing; Internet protocol networking; and domain name service.

Corporate Focus

NASA's space communications networks are national assets that serve a wide range of customers. While management and budget authority is decentralized among the Enterprises, coordination is essential to ensure maximum benefit for all. A Memorandum of Agreement among the Enterprises establishes an integrated framework for managing shared capabilities.

The Space Communications Program integrates telecommunications activities and crosscutting issues for the Agency, including network priorities and capabilities, technology development, communications architecture, and the management of spectrum resources and data standards. We address these issues in conjunction with all the Enterprises and Centers through a management coordination board and working groups. We lead NASA in formulating an Agency posture for external stakeholders, including the Administration, Congress, Government agencies, and international partners.

Space Mission Communications and Data Services

As the manager of the Space Network and the NISN, we coordinate with internal and external customer organizations to provide communications and data services for a variety of missions. Customers for the Space Network include the Space Shuttle; the Space Station; the Hubble Space Telescope; and Earth science satellites, including those that compose NASA's Earth Observing System. The Space Network also provides communications for ELVs including the Delta IV and Atlas V, research aircraft, and spacecraft launched by Europe and Japan. The NISN supports customers at all NASA Centers, by providing IT networks, telecommunications infrastructure, and applications software.

Commitment to Flight

The Space Network supports a wide range of internal and external Agency customers 24 hours per day, 365 days per year. The Space Station, Shuttle, ELVs, and a variety of space science and Earth science satellites are among the spacecraft that use the Space Network's Tracking and Data Relay Satellite System to enable safe and effective spacecraft operations.

Provide Cost-Efficient, Interoperable Space Communications Services (Years 0–20)

Our space communications strategy is aimed at optimizing the interoperability of NASA's communications systems, thereby minimizing the cost and complexity of current and future space networks.

Focusing on our strategic goal of ensuring space access, we will work with NASA's Space Architect and all NASA Enterprises to do the following:

- Determine the Agency's emerging space communications needs
- Develop and evaluate future space communications architectures
- Coordinate and integrate next-generation architectures across the Agency

Enhanced communications architectures will increase compatibility among network nodes and streamline current and projected requirements for network connectivity, security, and manageability.

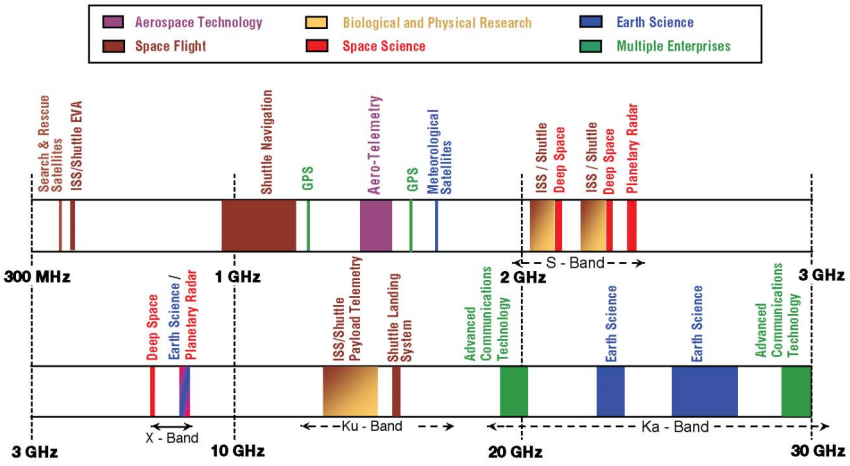
Space Communications Planning

We conduct comprehensive space communications planning to ensure adequate system interoperability and access to spectrum resources. We manage space data standards and spectrum resources for all NASA organizations and ensure proper Agency representation in national and international policy-making forums. We lead the development of NASA's space communications architecture by assessing long-term mission requirements in conjunction with other Enterprises, by advocating appropriate investments, and by coordinating with the DOD to substantially improve the effectiveness of our space communications assets.

Space Communications Technology Development

The Space Communications Program invests in the development of new technologies. Agencywide plans for the evolution of NASA's space communications architecture are used as guidance to establish requirements for developing enabling technologies. Through the joint efforts of the Space Communications and Advanced Systems Programs, the Space Flight Enterprise works closely with the Aerospace Technology Enterprise to coordinate investments. Together, we invest in selected technology proposals from NASA Centers and promote collaboration between NASA Enterprises and with external partners like DOD and the National Oceanic and Atmospheric Administration. The focus of the efforts by the Space Flight Enterprise is to advance the maturity of promising new technologies, perform flight demonstrations, and eventually migrate the technologies into operational systems.

A key means of executing our strategy to improve interoperability is the advocacy of effective national and international space data standards. We provide Agency and national leadership in this area, working with the principal international coordinating body, the Consultative Committee for Space Data Systems, and other organizations to build consensus on standards, promote the implementation of solutions, and assess the effectiveness of existing interfaces.



Representative NASA Spectrum Use (300 MHz - 30 GHz)

Resulting benefits include a better understanding of exchanged data; reduced mission complexity and risk; and reduced cost as a result of faster system development and testing, fewer training requirements, more commercial off-the-shelf hardware, and more automation. Long-term objectives include developing communications and data protocols to meet the needs of future optical communications and other emerging broadband capabilities.

Another strategic priority is to ensure that adequate radio frequency spectrum is available to support the communications requirements of all Agency programs without interference from other communications activities. To this end, we spearhead NASA's advocacy for dedicated radio frequency sensing in space-based research. For example, the Ka-band capability provided by the three most recently launched TDRS satellites, as well as planned upgrades to the space-to-ground link terminals, will give NASA missions greater ability to communicate without radio interference. We will continue to monitor spectrum issues vigorously to protect NASA's future communication and research needs. This monitoring requires effective coordination with national and international regulatory bodies.

Management Excellence

Long-term planning is essential to ensuring that NASA's space communications infrastructure remains as effective and efficient as possible and can respond in an agile and flexible manner to evolving customer requirements. By developing a seamless space communications architecture, promulgating space data system standards, and ensuring adequate spectrum resources, NASA seeks to minimize redundancy and overlap and to improve network reliability, interoperability, manageability, and bandwidth.

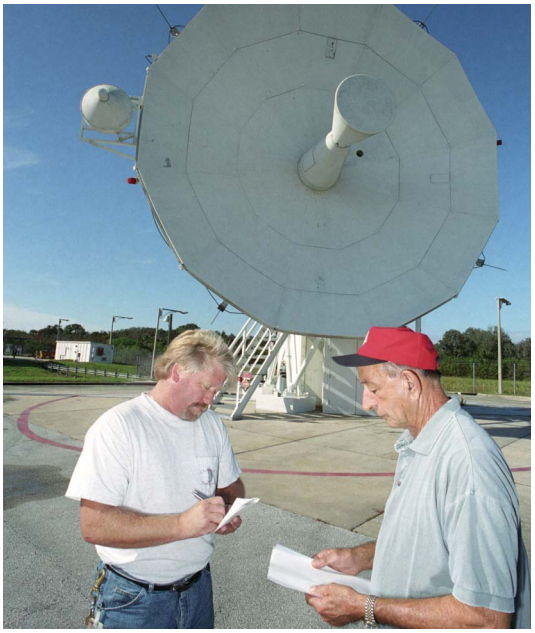
NASA is restructuring space communications management to improve financial performance while continuing to support all space communication requirements. NASA's space communication efforts are now managed at Headquarters. Budgets are distributed among the Enterprises based on mission requirements, and the Enterprises have formalized an agreement to establish a coordinated management structure. In addition, an Agencywide procurement solicitation for space mission communications and data services will result in multiple Enterprise-guided, Center-managed contracts. These procurements are designed to enhance efficiency and clarify NASA management accountability by aligning contract administration with programmatic and budgetary responsibility. These actions also expand competition, in accordance with the competitive sourcing initiative of the President's Management

Nurturing the development of advanced communications technologies also is an essential component in our strategy. We give priority to investments in technologies and techniques that promise to yield significant advances in performance, substantially decrease cost, or contribute to the development of a more fully integrated communications and operations architecture. With these investments, we strive to enable new science mission capabilities and improved productivity.

We also strive to incorporate advanced technologies within our communications systems once they are operational. For example, in concert with the Agency Chief Information Officer, we intend to modernize the general-purpose NISN backbone by upgrading our Wide Area Network technology over the next 2 years. This will significantly improve the bandwidth, availability, and security of the networks that carry voice, video, and data between NASA Centers. As a result, we will enable routine, virtual "One NASA" teaming of scientists, engineers, accountants, and other work groups.

We also represent NASA in the development of the national transformational communications architecture, and we are coordinating closely with DOD's Transformational Communications Office to ensure compatibility. This effort is studying the potential of several technologies, including lasers, packet switching, and the Internet Protocol, to bring about dramatic improvements in interoperability, access, and bandwidth.

Characteristics of the transformational communications architecture are expected to become clearer within this decade. By 2010, the DOD plans to launch the first communications satellite resulting from this effort. The ultimate architecture, including the extent to which laser communications are incorporated, will drive future requirements for NASA's Space Network. It will influence the Agency's strategy for replenishing and maintaining the TDRS system. Based on current models, initial replenishment of TDRS satellites will be required in the 2012 timeframe.



Agenda. We also promote cost-effectiveness by using competitive sourcing principles to evaluate and buy commercial off-the-shelf hardware products whenever it is practical to do so.

The Space Communications Program, like all of NASA, is transitioning to full-cost accounting, which will allow us to charge fees to other Enterprises that use the networks beyond an established base allotment. Full-cost accounting, therefore, is helping to inform program managers of the true cost of communications and data services and contribute to improved financial management.

In close consultation with NASA's Chief Information Officers at the Agency, Enterprise, and Center levels, we conduct periodic performance assessments of the NISN to improve the management of knowledge across the Agency. The NISN, a centerpiece of the Agency's IT infrastructure, is based on an outdated architecture that is becoming more expensive to maintain. Accordingly, the Space Communications Program and the Chief Information Officers are examining the potential of a modernized architecture to improve the network's speed, interoperability, reliability, security, and cost efficiency.

Reaching for a Vibrant Future

Advances in space communications, coupled with improved ability of other space systems to be remotely reconfigured, promise to usher in a new generation of space missions with dramatically improved capability and scientific return.

Evolved Space Communications Architecture (Years 10–20)

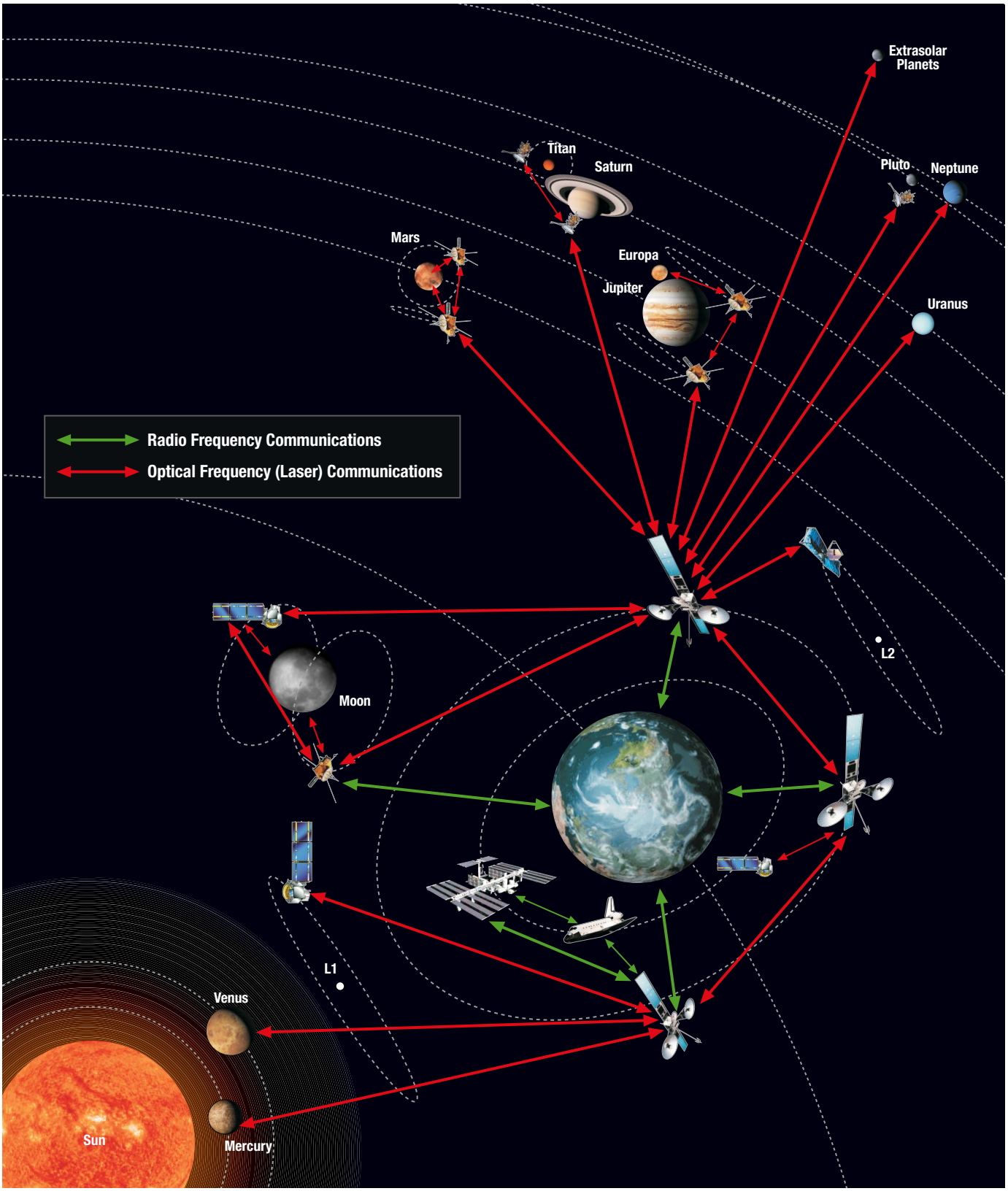
Crucial in reaching NASA's strategic goal of ensuring and improving access to space is the development of a space communications architectural plan that accommodates evolving space missions. The Space Flight Enterprise, in coordination with other NASA Enterprises and other U.S. Government agencies, will develop a space communications architectural framework for the future to enable progressively more capable human/robotic missions of exploration and discovery. The architecture will address the needs of spacecraft operating in both near-Earth and deep-space regions and will leverage technology investments made by NASA and other Government agencies, as applicable.

NASA anticipates continuing demand for ever-higher data transmission rates to fully maximize scientific return from our space missions. Therefore, a major objective of our space communications architecture will be to provide ample high-data-rate connections to spacecraft operating in both near-Earth and deep space in a manner that does not constrain mission capability.

NASA's space communications architecture will be flexible and will accommodate capabilities such as software-programmable radio technology and Internet-like features. Where cost beneficial, it will integrate multi-Enterprise needs by incorporating, for example, relay satellites that support both Earth-orbiting spacecraft and deep-space operations. Interoperability with other Government agency space and terrestrial networks also will be considered where efficiencies can be realized.

During the next 10 to 20 years it is envisioned that our space communications networks will utilize both radio frequency and laser communication techniques and will be engineered along with the spacecraft of the future as a part of our space exploration system. This system will support expanded throughput of data, voice, and video transmissions among spacecraft; outposts; and Earth-bound mission controllers, scientists, and fellow explorers from the public.

The future space communications framework will encompass the efforts of all NASA Enterprises (a possible framework is illustrated on the right). This includes the evolution of NASA's Deep Space Network, as managed by the Space Science Enterprise, as well as new optical communications technologies that are being developed by the Space Science and Aerospace Technology Enterprises.


Extrasolar Planets
Titan
Saturn
Pluto
Neptune
Mars
Europa
Jupiter
Uranus
Radio Frequency Communications
Optical Frequency (Laser) Communications
L2
Moon
L1
Venus
Sun
Mercury

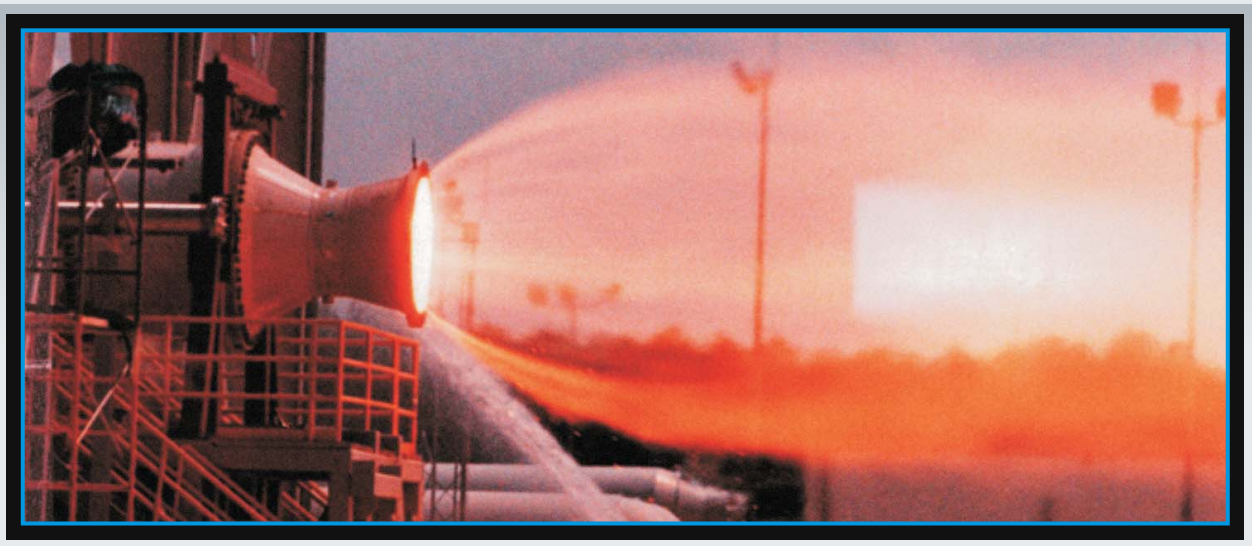
Rocket Propulsion Testing

The Rocket Propulsion Test Program provides the core engineering and technology base to operate, maintain, and enhance test facilities at the Stennis Space Center in Mississippi, the Marshall Space Flight Center in Alabama, Johnson Space Center's White Sands Test Facility in New Mexico, and Glenn Research Center's Plum Brook Station in Ohio. The facilities test rocket engines and engine components used in current flight vehicles, including the Space Shuttle and commercial vehicles. They also test future rocket propulsion technologies and systems.

Strategic goal 8.—Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.

Strategic objective 8.5.—Provide services for rocket propulsion testing . . . in support of NASA, other Government agencies, and industry.

—From the NASA Strategic Plan



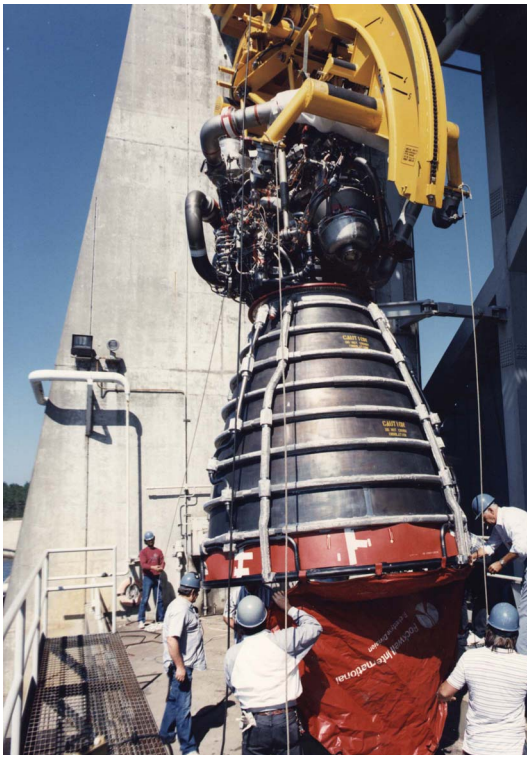
The timeline above highlights strategic priorities for the Rocket Propulsion Testing Program over the next 20 years. Milestones are for planning purposes and depend on safety and budgetary requirements.

Commitment to Flight
Facilities for rocket propulsion testing are essential for promoting innovation and safety in space transportation.

Evolution of Priorities for Rocket Propulsion Testing

Through at least the beginning of the next decade, our Space Shuttle Program will continue to rely on these facilities extensively. The facilities are used to test all Space Shuttle Main Engines as well as the Orbital Maneuvering System and Reaction Control System engines before they are installed on an orbiter and used in flight. Additionally, NASA's Aerospace Technology Enterprise will rely heavily on test facilities to support the design, risk reduction, and development of future propulsion technologies. To meet customer requirements now and in the future, the Rocket Propulsion Test Program must maintain necessary core capabilities and incorporate new technologies and methodologies that enhance test facilities.

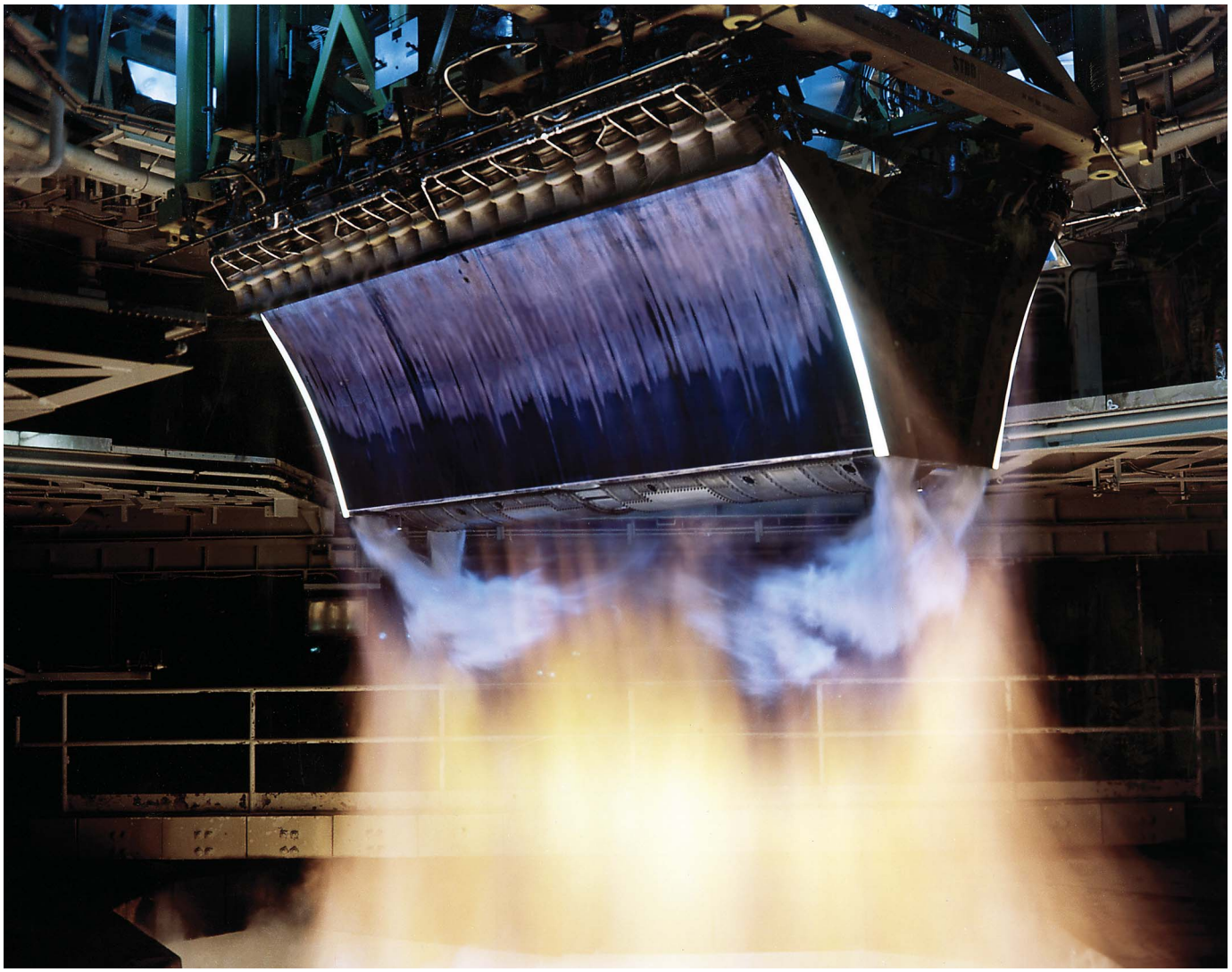
The Rocket Propulsion Test Program will assist in the development of innovative propulsion technologies by working closely with NASA's Space Architect, the Aerospace Technology Enterprise, and the Space Flight Enterprise's Advanced Systems Program.



Corporate Focus
Meeting the requirements of NASA customers, other Government agencies, and industry is the focus of the Rocket Propulsion Testing Program. To ensure the safe and efficient use of our widely dispersed facilities, representatives from all Agency propulsion test sites participate in a Rocket Propulsion Test Management Board. The Board, chaired by a program executive from Stennis Space Center, evaluates facility needs, establishes priorities for facility improvements, and makes test assignments. Similarly, a National Rocket Propulsion Test Alliance formed by an agreement between NASA and DOD meets regularly to promote intra- and interagency cooperation in meeting national test needs, to encourage shared use of assets, and to shape the Government's rocket propulsion testing capability.

Reaching for a Vibrant Future

Safe, reliable, and affordable propulsion engines are essential for future space travel. Representatives from the Rocket Propulsion Test Program actively serve on the Earth-to-Orbit working group chartered by NASA's Space Architect to develop options for future space transportation systems.



Management Excellence

Innovation in real property management helps ensure management excellence. The Rocket Propulsion Testing Program must continually assess NASA's propulsion development forecasts to make sure that NASA's facilities can meet unique rocket development and certification testing requirements in a timely manner. The portfolio of test assets will be reviewed regularly to avoid duplication, demolish unneeded or outdated facilities, and dispose of excess real property. To minimize the construction of new facilities, we will form partnerships and share facilities with other Federal agencies, State and local governments, and universities.

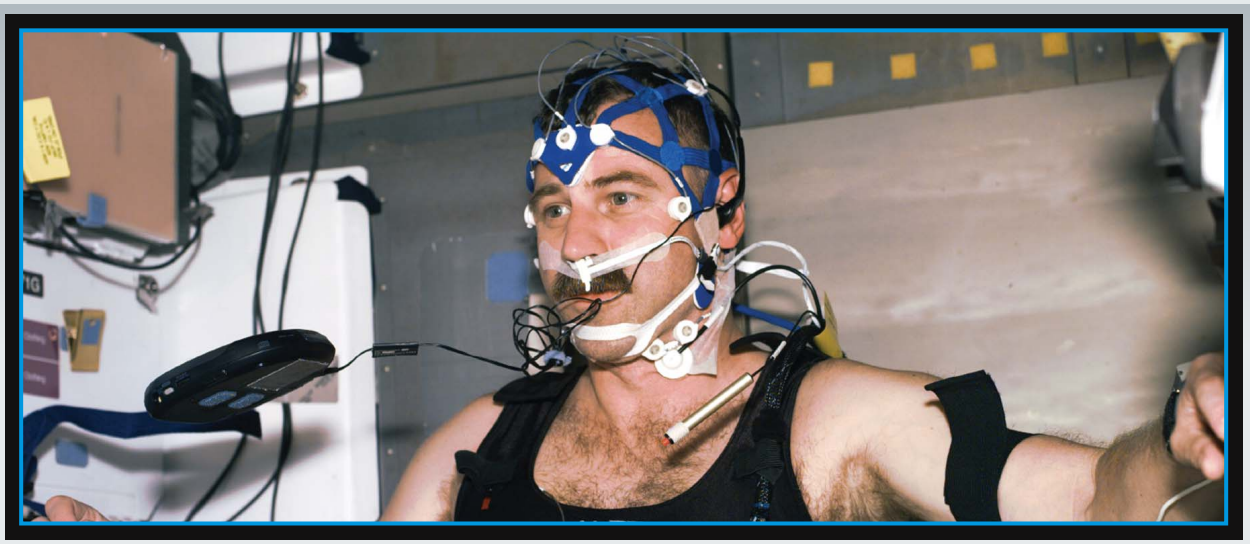
Crew Health and Safety

The Crew Health and Safety Program protects our astronauts from the hazards of space travel and identifies methods that allow astronauts to improve their performance. We systematically identify and assess critical health and safety risks and develop risk-management solutions that enable informed decisions, and enhance human health, safety, and performance.

Strategic goal 9.—Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.

Strategic objective 9.1.—Understand human physiological reactions to reduced gravity and develop countermeasures to assure survival of humans traveling far from Earth.

—From the NASA Strategic Plan



The timeline above highlights strategic priorities for the Crew Health and Safety Program over the next 20 years. Milestones are for planning purposes and depend on safety and budgetary requirements.

Commitment to Flight

We certify the medical health of astronauts before flight and provide them with medical care throughout their lives.

In carrying out our crew health, safety, and performance responsibilities, we do the following:

- Manage the risk of adverse health or performance impacts to the crew or the mission from medical or psychological conditions
- Manage environmental risks, such as exposure to radiation, excessive noise, or problems with the water or air supply
- Ensure the crew's ability to meet all mission demands, including piloting, extravehicular activities, operational demands, and emergency egress
- Follow a continuous improvement approach for existing systems, processes, equipment, and technology to maximize crew health, safety, and productivity
- Evaluate results of biomedical and space medicine research to determine potential applications on Earth

We provide health care to the entire astronaut corps, both in space and during ground-based training. We work cooperatively with NASA's Chief Health and Medical Officer and NASA's Biological and Physical Research Enterprise to manage the health risks inherent in space travel.

We perform medical and environmental monitoring, identify health and safety concerns and design countermeasures, develop and apply new emergency life-support and medical technologies, and implement process and design improvements that increase the time the crew can devote to primary mission activities.

Corporate Focus

Our principal customers are the astronauts who venture into space. We ensure their health and safety and provide them with the tools they need to improve their performance in space. Our aim is to create an outcome-driven program that delivers effective and efficient risk-management solutions for living and working in the space environment.

To optimize the medical services, we coordinate with the NASA organizations responsible for medical operations, research, and policy. The Space Flight Enterprise's Crew Health and Safety Program provides medical support. NASA's Biological and Physical Research Enterprise leads a research program to develop biomedical countermeasures and create advanced human-support technologies. NASA's Chief Health and Medical Officer establishes medical policy. Together, the three organizations have created a unified bioastronautics strategy.

Evolution of Priorities for Crew Health and Safety

The experiences of those living on the Space Station will help us to better understand the effect of space on the human body and the effect of isolation on human behavior and performance. The Space Station also affords us a place to test advanced emergency life-support systems, clinical and surgical capabilities, and nutrition. Through these activities, we can mitigate health and safety risks in the future.

NASA has identified 55 critical risks that will guide future investments in the research and development of countermeasures. We are working with a variety of private and public partners to answer our critical questions so that we can achieve current and future goals for human exploration. Priorities for crew health and safety will evolve as we gain more flight experience and learn from research. NASA's research plans are described in the strategy for the Biological and Physical Research Enterprise.

As we develop new methods of counteracting the health and behavior risks of space flight, we will focus on defining medical requirements for space flight beyond Earth's orbit. We will implement a comprehensive health-care program, including crew certification and health-maintenance activities. We also will develop minimally invasive technologies for monitoring, diagnosing, and treating medical and surgical conditions that may arise during these missions. We will validate countermeasures using ground facilities and the Space Station. We will develop and maintain a comprehensive medical information system to manage health, safety, and performance risks during lengthy space missions. Most importantly, we will work to enhance the autonomy and efficacy of health-care systems created for the space environment.

Management Excellence

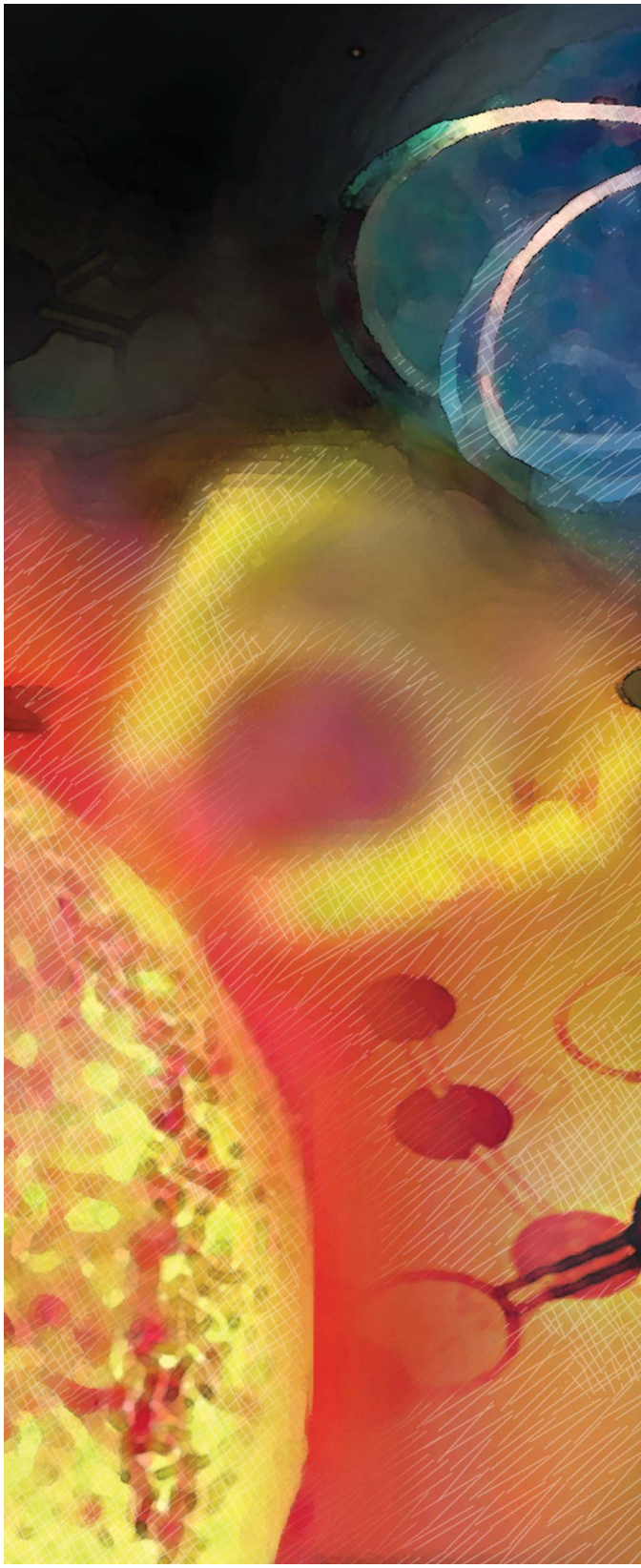
We support timely and informed decisionmaking by implementing sound project-management practices. These practices include enhanced information technology and communications processes, which allow us to share and evaluate vital medical information rapidly and securely.

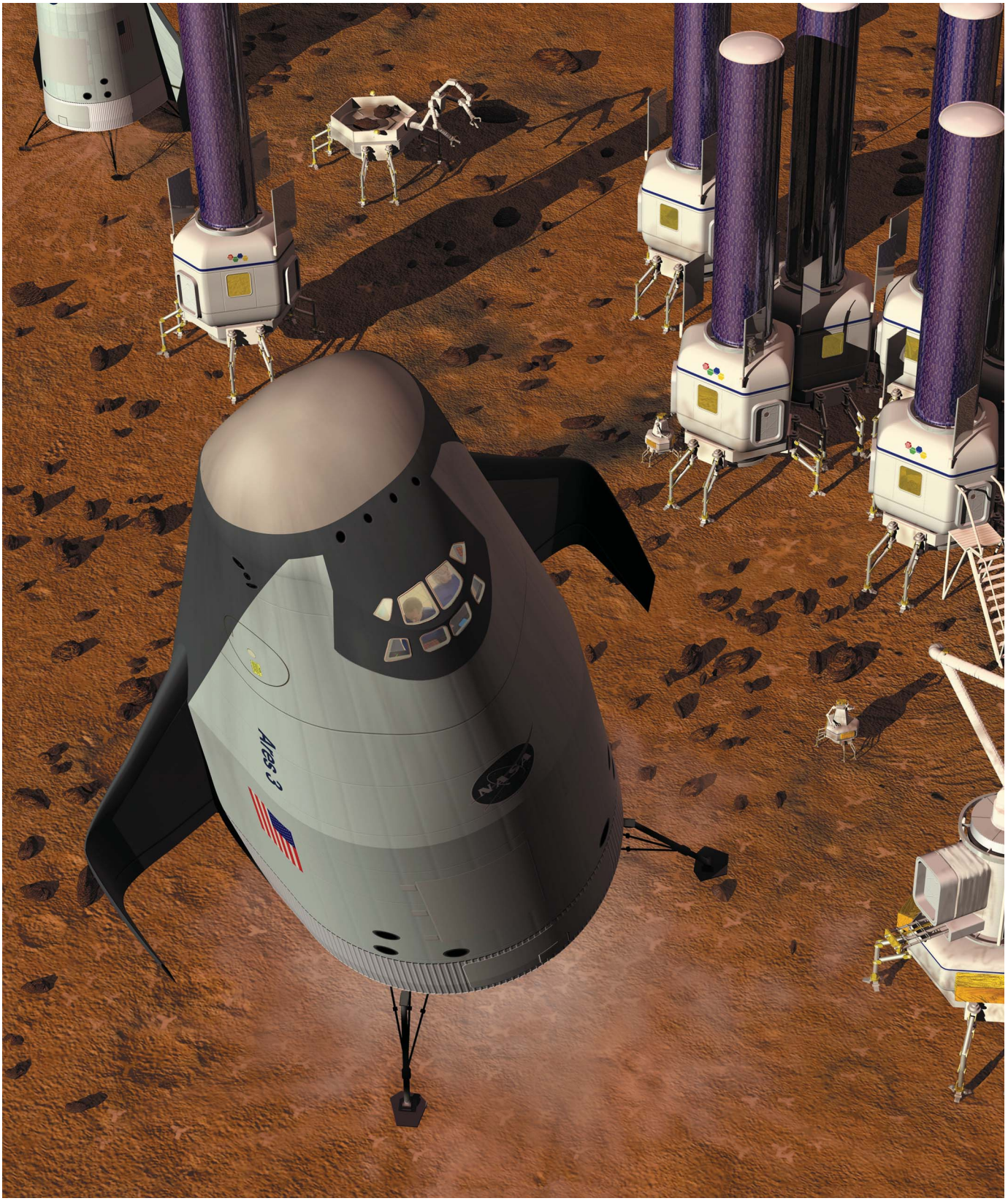
To develop the best possible medical solutions, we must consult extensively with leading clinical experts. We rely on discipline experts to help us identify health and safety risks. Further, we will consult with our academic, industry, and international participants to create integrated risk-management solutions.

Reaching for a Vibrant Future

NASA will develop health-care safety approaches and solutions that enable long-duration human space flight.

Based on knowledge gained from the Space Station, the Shuttle, and ground-based research, NASA's Human Research Initiative, led by the Biological and Physical Research Enterprise, is creating new techniques that will allow us to overcome the physiological and psychological problems that currently limit human space flight. The goal is to enable missions that go beyond low-Earth orbit and last longer than 100 days. As new countermeasures are developed, the Crew Health and Safety Program will implement new medical policies and procedures so that we can fulfill NASA's goal of extending the duration of human space flight.




NASA

Advanced Systems

"Humanity's greatest adventure has just begun." —NASA Strategic Plan

NASA's Strategic Plan outlines a bold mission for our future: "We will continually advance the boundaries of exploration and our knowledge of our home planet and our place in the universe. We seek answers along many paths, multiplying the possibilities for major discoveries. The capabilities we develop will eventually enable humans to construct and service science platforms at waypoints in space between Earth and the Sun. Someday, we may use these same waypoints to begin our own journeys into the solar system to search for evidence of life on Mars and beyond."

Strategic goal 8.—Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.

Strategic objective 8.6.—Create concepts, technologies, and capabilities for space transportation that enable affordable future infrastructures.

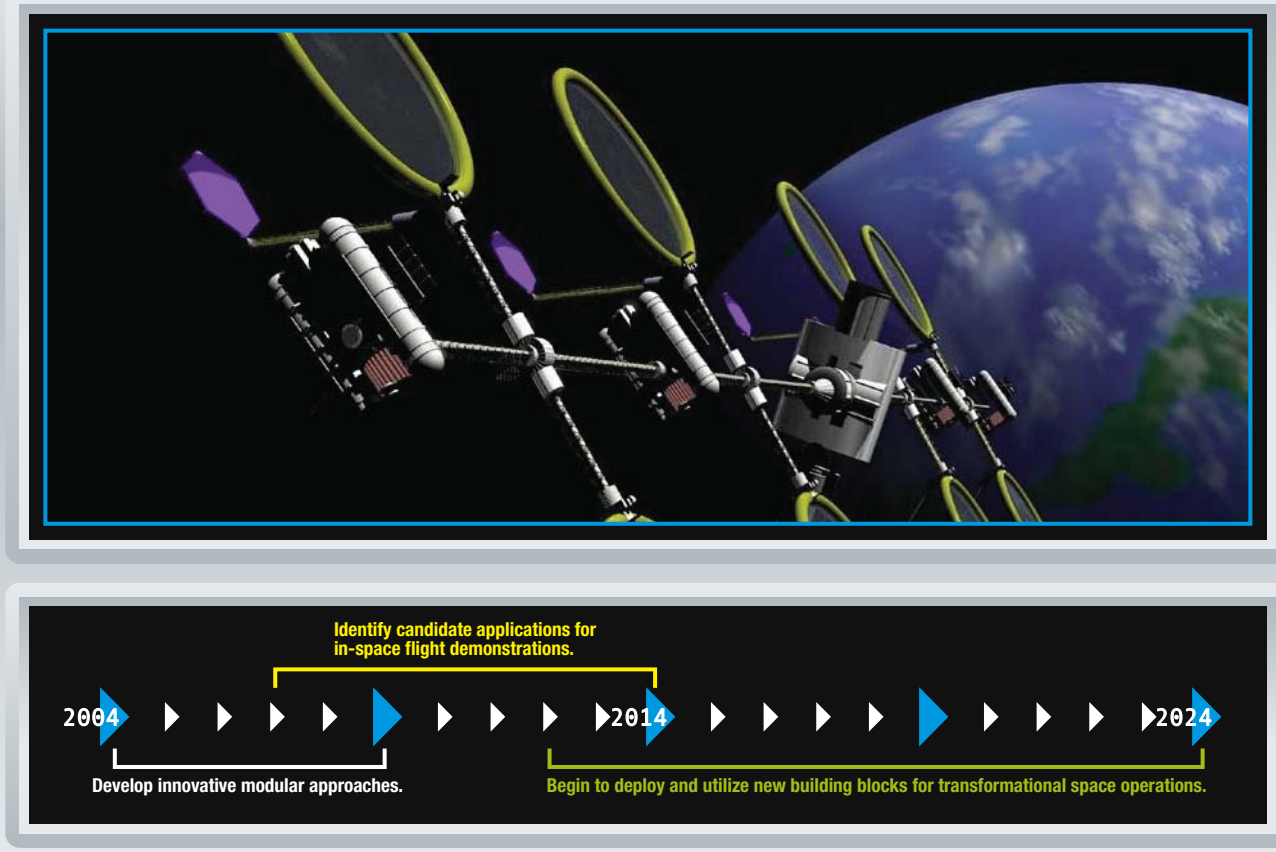
Strategic goal 9.—Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.

Strategic objective 9.4.—Develop innovative concepts for systems, infrastructures, and missions to extend the duration and boundaries of human space flight.

Strategic goal 10.—Enable revolutionary capabilities through new technology.

Strategic objective 10.4.—Create novel aerospace concepts and technology to support future sustainable human and robotic exploration and development of space.

—From the NASA Strategic Plan



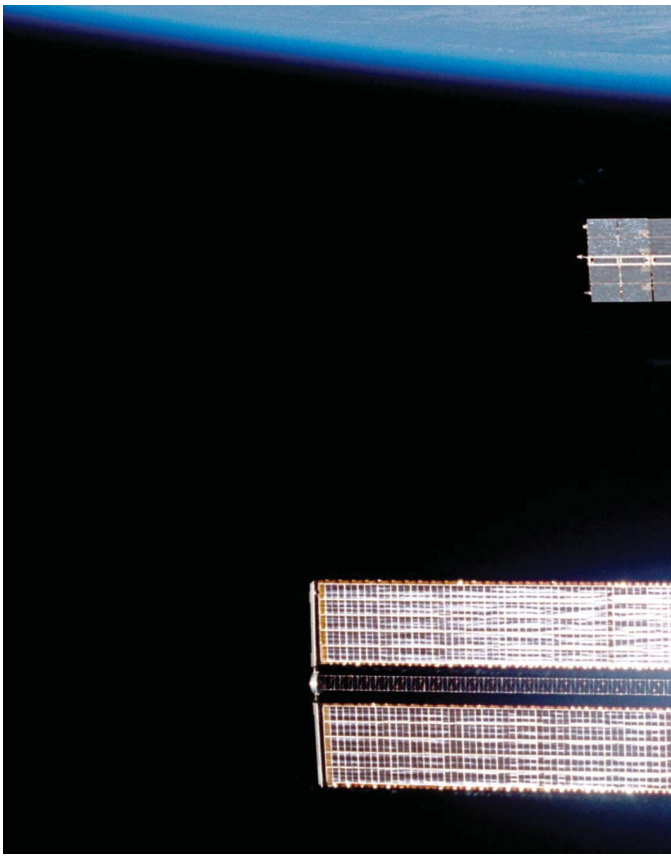
The timeline above highlights strategic priorities for the Advanced Systems Program over the next 20 years. Milestones are for planning purposes and depend on safety and budgetary requirements.

The NASA Space Architect coordinates NASA's planning for future activities in space and all NASA Enterprises participate in this effort. For example, the Aerospace Technology Enterprise is responsible for developing new Earth-to-orbit space transportation technologies and capabilities. NASA's Biological and Physical Research Enterprise is responsible for the Human Research Initiative that will help us better understand and mitigate the physiological and psychological limitations of space flight, using the Space Station as a test bed. And NASA's Space Science Enterprise is acquiring information regarding environments in Mars orbit and on the martian surface to inform decisions concerning future human/robotic exploration.

The Space Flight Enterprise's Advanced Systems Office will complement and integrate these research and development efforts by identifying and developing options for human/robotic exploration. The Advanced Systems Office will pursue the revolutionary capabilities necessary for establishing and utilizing new human and robotic outposts in space.

"For I dipped into the future, as far as human eye could see, saw a vision of the world, and all the wonder that would be."

—Alfred Lord Tennyson



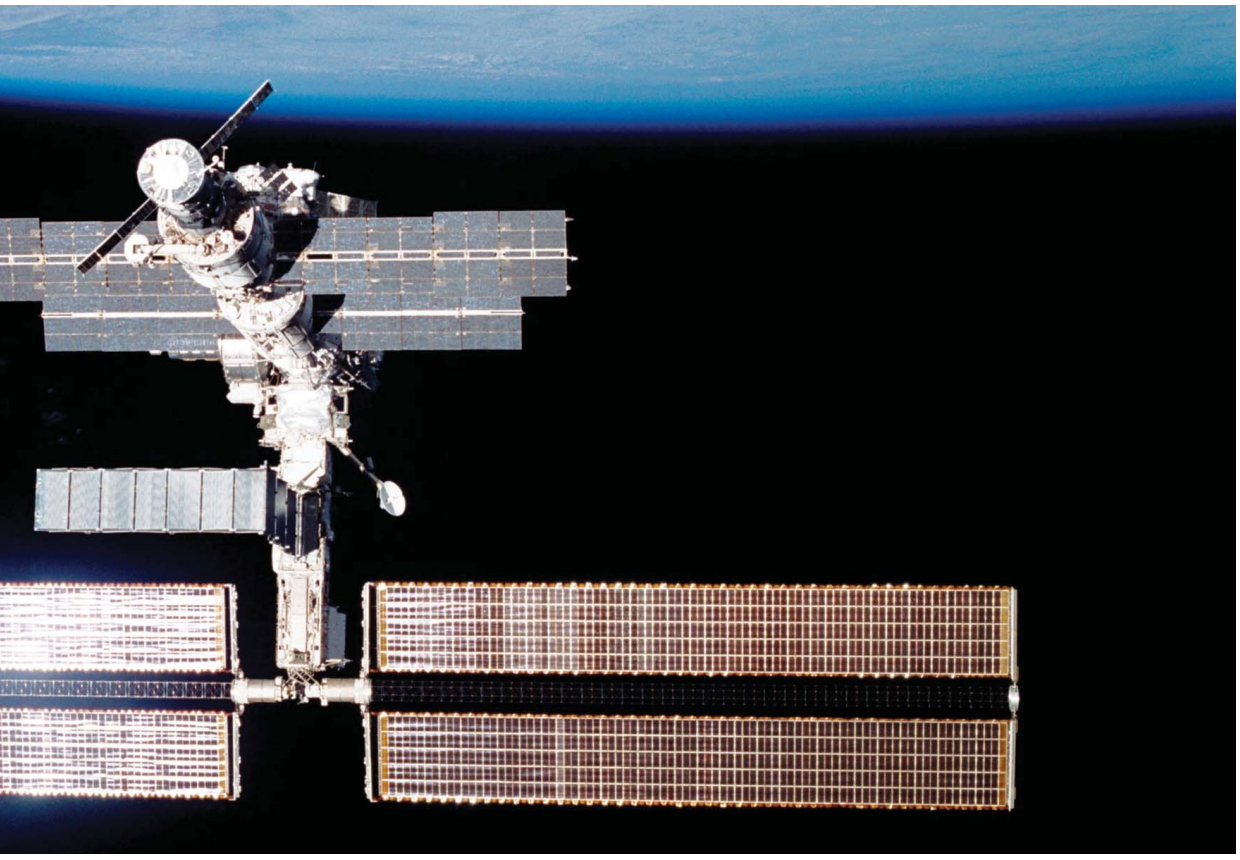
Commitment to Flight

We will develop advanced space systems that are safe, affordable, and effective. As a modular system, the Space Station is the conceptual foundation for our strategy. We will learn from the Space Station experience so that we can "leap frog" to our future.

To open new pathways of exploration and discovery, NASA develops "building blocks." In the Apollo program, NASA built and fully integrated on Earth the components that were to be used on the Moon and relied on a heavy-lift vehicle to transport them.

When the Apollo program concluded, NASA shifted to the Space Shuttle, a largely reusable vehicle designed to lift smaller payloads that could be assembled into large systems in space. Later, the International Space Station Program was developed based on this approach.

This engineering approach has worked well. By building the Space Station in modules for assembly in space, the International Space Station Program makes optimal use of Shuttle capabilities, provides a framework for international partnerships, and demonstrates the vitality of an engineering approach that relies upon flexible development and deployment. This modular "building block" approach is the conceptual foundation for the strategy our Advanced Systems Office will pursue to enable the creation of transformational new capabilities, infrastructures, and outposts in space for our future.



Develop Innovative Modular Approaches (Years 0–5)

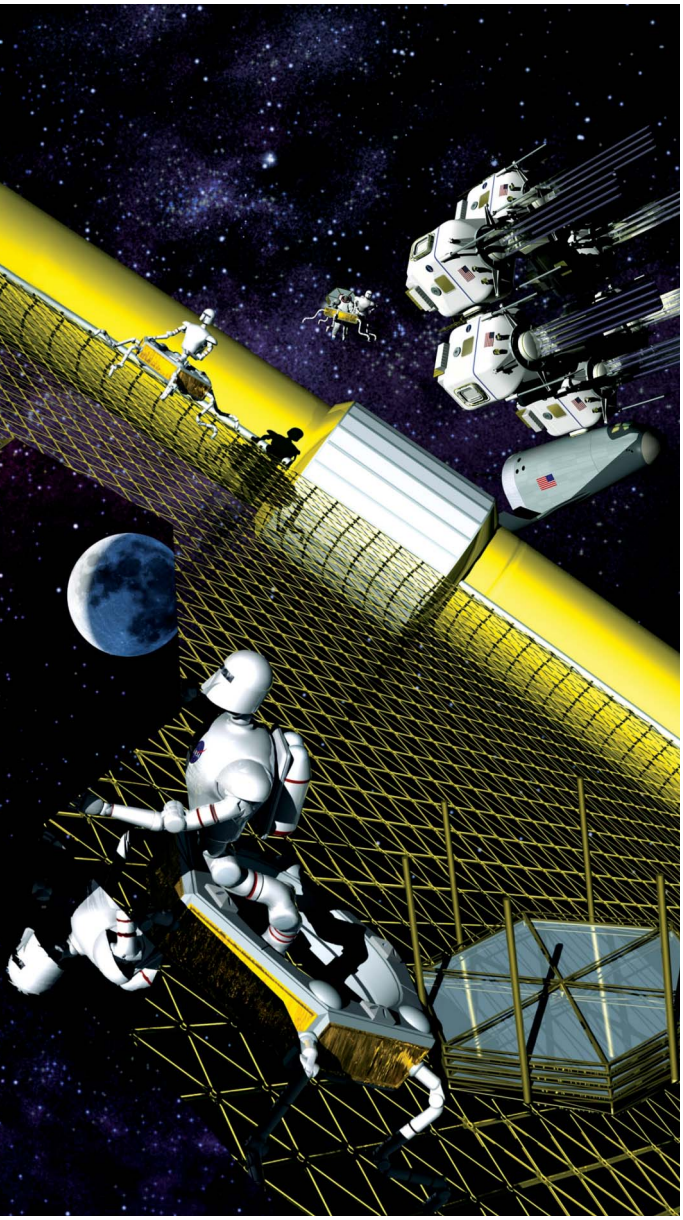
We will develop innovative modular concepts for systems and infrastructures that will advance human and robotic exploration of space. By synthesizing exciting advances being made in a range of technology disciplines—including computing, software, and materials—we will create new systems concepts and space mission architectures that will transform future space exploration. We will carefully analyze options through trade studies that we will conduct in coordination with other governmental agencies to determine the best investments NASA can make. We will pursue investments in research, technology, and demonstrations to validate these concepts.

The knowledge we acquire through research and trade studies, as well as the experience we gain from operating the Space Station, will be synthesized into specific plans and programs that will create new capabilities for future space exploration. Where possible, we will leverage our investments by partnering with other Government agencies in order to best advance space infrastructure for the Nation.

A core component of this strategy will be to develop innovative approaches to partnerships with universities. We will do this in a way that involves the next generation of scientists and engineers in creating, designing, and crafting new approaches for our future. In this way, we will capture student energy and innovation and begin to train new engineers and scientists to join our workforce in the future.

Corporate Focus

We coordinate our activities for the Advanced Systems Program with the NASA Space Architect and all other NASA Enterprises. Because other NASA Enterprises are responsible for advances in space transportation, our Advanced Systems Program focuses on innovations necessary for creating new infrastructures and outposts in space. To do this, we will build on the modular engineering technique used to construct the Space Station. We will also rely on the NASA Space Science Enterprise's robotic scientific exploration of potential human destinations—Mars, the Moon, and asteroids, for example—to provide key data on the risks and rewards of exploring these worlds. We will be agile and flexible in achieving our goals. We will seek, where appropriate, innovative partnerships with academia, the private sector, other governmental agencies and other nations to advance our goals as well as those of our partners. Finally, we will mold all of our activities so that the next generation of scientists and engineers can participate substantially.



Identify Candidate Applications for In-Space Flight Demonstrations (Years 3–10)

By the end of this decade, we will seek to identify and validate revolutionary approaches that might be realized in the mid- to far-term. We will advance this aspect of the strategy through ground and flight experiments and demonstrations.

To further our long-term exploration planning, we will use the Space Station as a proving ground for testing and deploying advanced space systems. We will complete detailed analyses of options, accompanied by focused technology development and testing to inform analytical studies.

Where appropriate, we will complete higher fidelity ground tests and maturation through in-space technology demonstrations to provide detailed insight into the costs, risks, and improvements in performance that might be expected from operational infrastructures based on identified concepts and technologies. Toward the midpoint of this time period, we envision decisions about full-scale development with an objective of achieving "first flight" of revolutionary capabilities during the next time phase.

Management Excellence

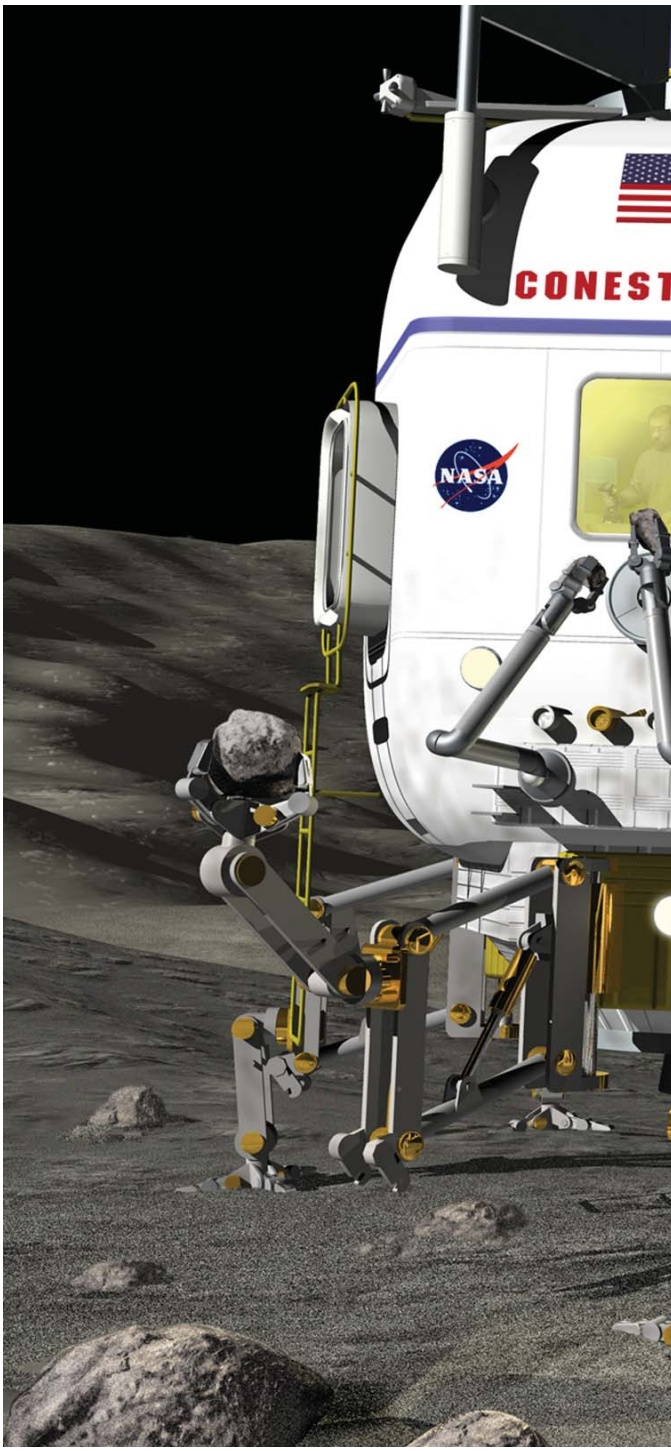
The best concept options for advanced systems will be selected through open competitive processes and will be developed by broadly based teams that span the Government, academia, industry, and other sources. We will implement management methodologies for advanced systems development that complement operational management structures. This effort includes assigning liaisons to work closely with every operational component within the Space Flight Enterprise to ensure an inclusive sharing of ideas and effective transitioning from concepts to development, and ultimately to operations. We will allocate appropriate facilities and staff to the development of new capabilities. We will use the Small Business Innovative Research and Small Business Technology Transfer programs to fund innovative research by small businesses that will better achieve our advanced systems objectives. We will mold the Space Flight Enterprise's investment in rocket propulsion test facilities to better support our advanced systems activities. We will also partner with other organizations in order to facilitate an agile and flexible response to new opportunities as they arise.

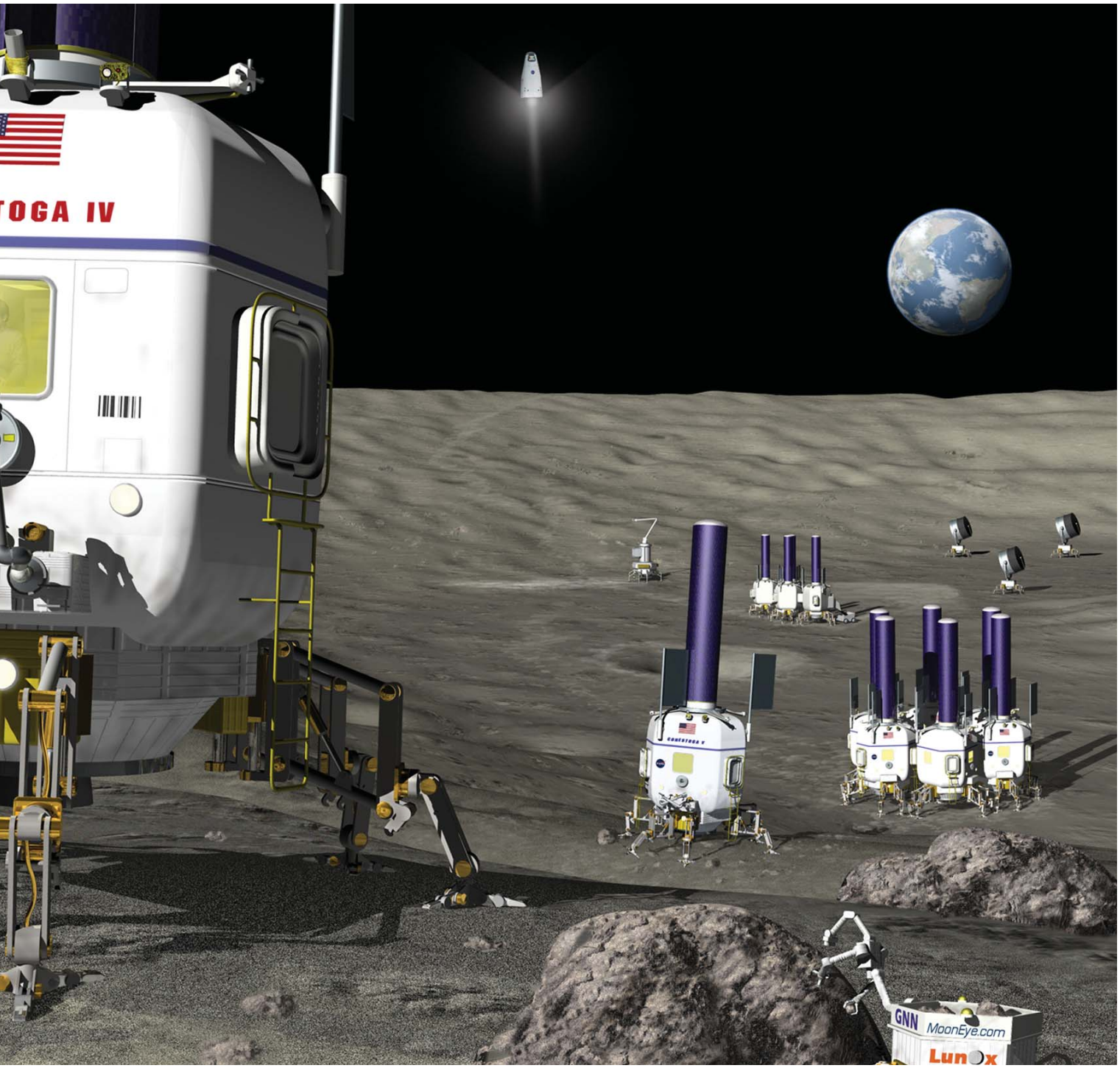
Reaching for a Vibrant Future

Applying a modular approach to developing ambitious in-space operations, we will establish revolutionary "wayposts" in space for exploration, discovery, and understanding.

Begin to Deploy and Utilize New Building Blocks for Transformational Space Operations (Years 8–20)

During this timeframe, the strategy is to continue research and technology development while periodically deploying specific new building blocks for ambitious, research- and exploration-driven space operations, as well as evolutionary upgrades to already-deployed systems. We cannot now predict the building blocks or missions that NASA and the Nation will select in the future, but our aim is to begin in-space use of at least one revolutionary space capability by 2015. Additional new capabilities will build on the first. These may include enhancements to the Space Station, another outpost in Earth orbit, a waypoint in space at one or more gravitationally balanced "libration" points in the Earth-Moon or Sun-Earth system, or an outpost on the Moon or in orbit around Mars. Our objective by the latter years of this timeframe is to make possible sustainable human-robotic activities beyond low-Earth orbit.

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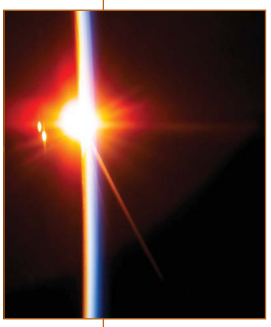
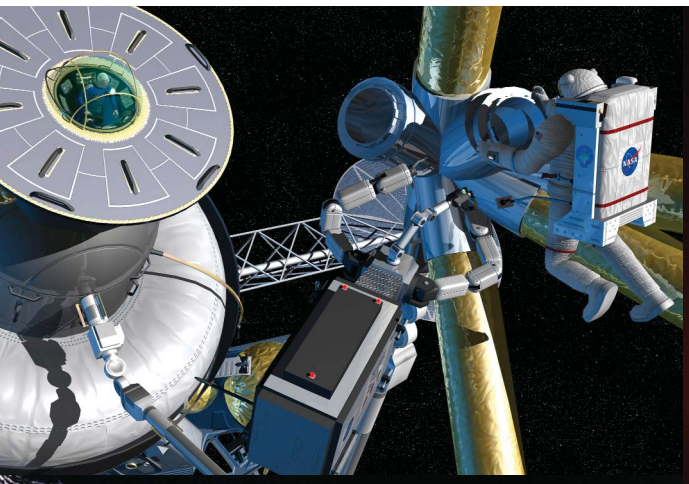
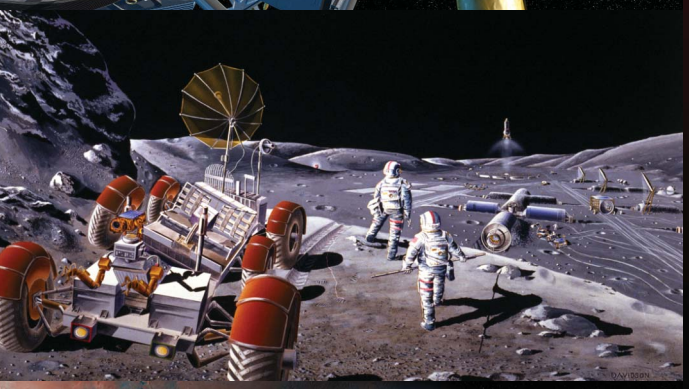
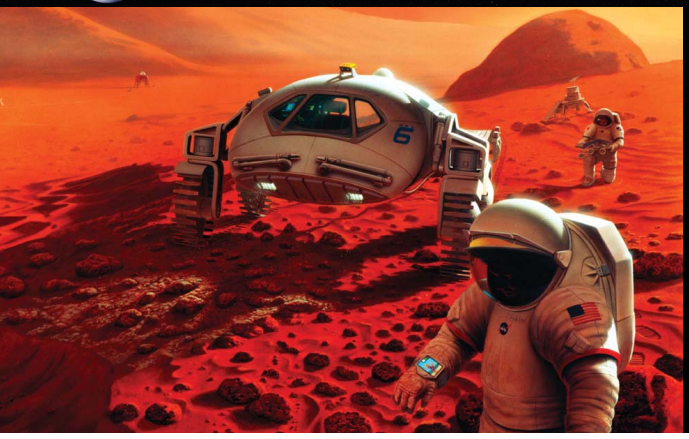


4 Beyond the Horizon







The Sun and Earth as photographed by the crew of Columbia (STS-107).

4 Beyond the Horizon

The desire to explore, discover, and understand—guided by the scientific process and empowered by our experience on the International Space Station—will foster the creation of new "wayposts" in space.

"Man, in his quest for knowledge and progress, is determined and cannot be deterred. The exploration of space will go ahead, whether we join in it or not, and it is one of the great adventures of all time, and no nation which expects to be the leader of other nations can expect to stay behind in the race for space."

—President John F. Kennedy, September 12, 1962

Over the next several decades, we envision:

- Missions to the Earth-Moon and Sun-Earth libration points (where gravitational forces are balanced) to establish national space infrastructure and operate revolutionary new telescopes
- Campaigns of human/robotic discovery on the Moon to advance technology, catalyze new discovery and understanding, and provide invaluable experience in how to sustain operations at other extraterrestrial locations
- Integrated, international human/robotic exploration of Mars and its moons and eventual missions to the asteroids located between the orbits of Earth and Jupiter
- Plans for human/robotic missions much later in this century to scientifically compelling destinations in the outer solar system such as Ganymede, an icy moon of Jupiter, and Titan, a moon of Saturn with an atmosphere similar to that of ancient Earth

The people who will engage in this future exploration are just now learning about the solar system in school.

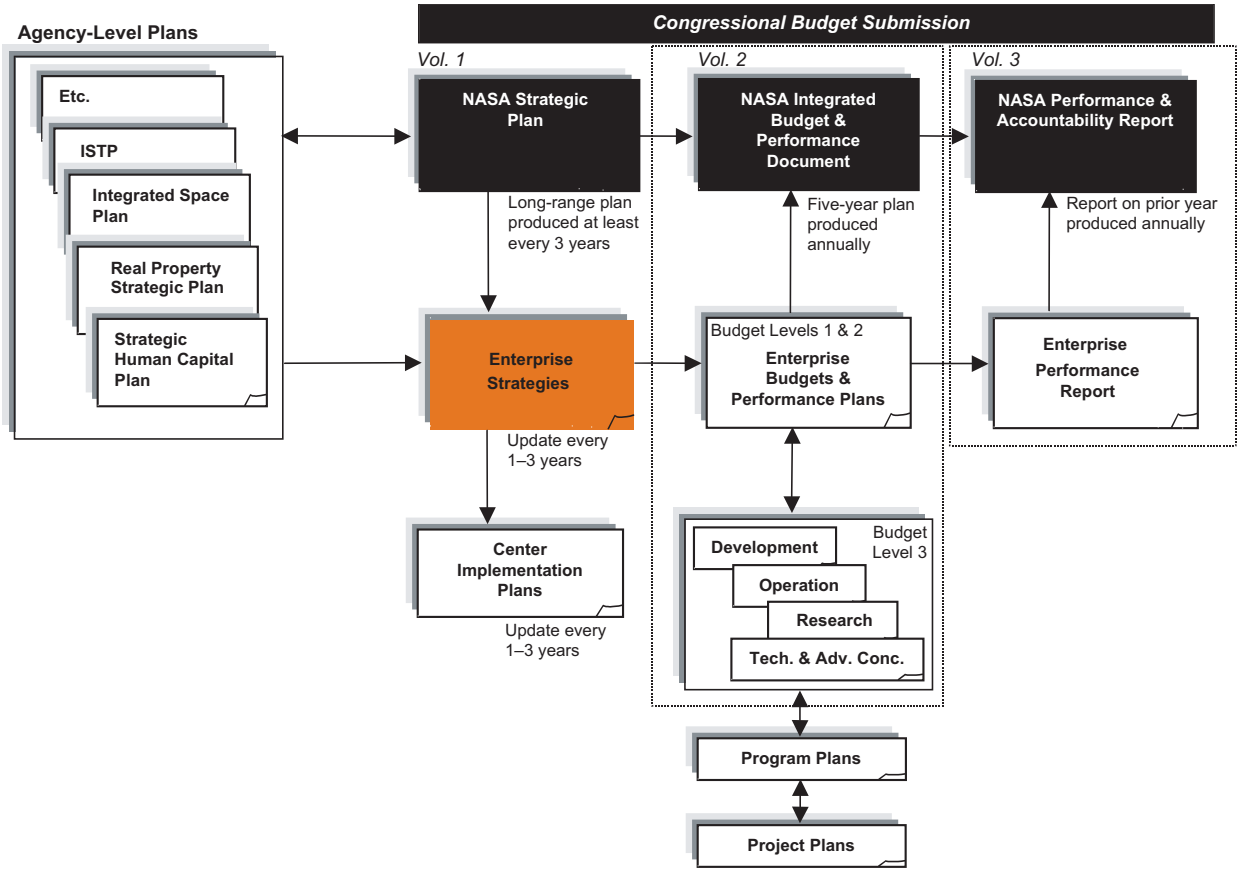
Our children's future is just beginning.

Appendices

Appendix 1: Strategic Implementation

Relationship to Agency Planning

The Agency's planning process includes the development of a Strategic Plan, the annual budget, and a performance plan. The Strategic Plan is a 5-year plan, updated every 3 years, that defines the Agency's goals and objectives. The NASA Enterprises base their planning on the strategic emphasis, the implementing strategies, the goals, and objectives outlined by the Strategic Plan. In addition, Enterprise budget planning and performance reporting are directly traceable to the Agency-level documents.



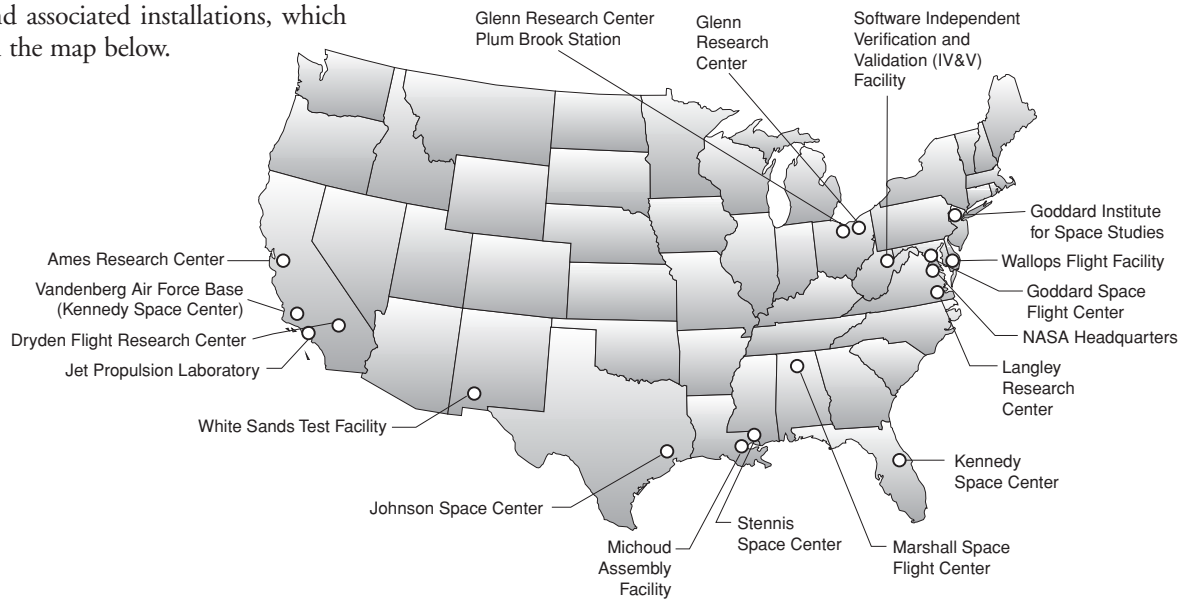
Stakeholder/Audience	Enterprise Strategy Function
Executive and Legislative Branches	Communicate purpose and value of investments
NASA Employees	Achieve alignment within the organization
Other NASA Enterprises	Strengthen inter-Enterprise collaboration
Science Community	Document consensus on objectives and priorities
Contractor Community	Communicate programmatic objectives and priorities
Interagency, International, and Commercial Partners	Establish basis for future collaborations
Public	Inform and inspire

The Enterprise Strategy communicates the results of the Agency and Enterprise planning processes to the NASA stakeholders and other audiences listed in the table at left.

To improve management processes, the Space Flight Enterprise relies on management implementation strategies being developed on an Agencywide level by NASA staff offices. The Agencywide strategies and the responsible staff offices are identified in the following chart. Information about the Space Flight Enterprise's management approach is described throughout this document under the category labeled "management excellence."

Implementing Strategies and Agency Lead Offices	Human Resources	Procurement	Chief Financial Officer	Comptroller	Chief Information Officer	Management Systems	Safety & Mission Assurance	Chief Engineer	Chief Scientist	Security Management & Safeguards	Chief Health & Medical Officer	Space Architect
IS 1: Achieve management and institutional excellence comparable to NASA's technical excellence.	•	•	•	•	•	•						
IS 2: Demonstrate NASA leadership in the use of information technologies					•							
IS 3: Enhance NASA's core engineering, management, and scientific capabilities and processes to ensure safety and mission success, increase performance, and reduce cost.							•	•	•			•
IS 4: Ensure that all NASA work environments, on Earth and in space, are safe, healthy, environmentally sound, and secure.						•	•			•	•	
IS 5: Manage risk and cost to ensure success and provide the greatest value to the American public.			•	•			•	•				•

The Space Flight Enterprise implements its activities by relying on the capabilities of all the NASA Field Centers and associated installations, which are illustrated on the map below.



The following chart illustrates how each Center supports the seven Space Flight programs.

Center Contributions to the Space Flight Enterprise

	International Space Station	**Core Development**	Flight Hardware	Operational Capabilities	Environmental Control and Life Support	**Spacecraft Operations**	Space Station Spacecraft Management	Space Station Elements	**Launch and Mission Operations**	**Operations Program Integration**	**Space Shuttle**	**Program Integration**	**Ground Operations**	**Flight Operations**	**Flight Hardware**	External Tank	Main Engine Production	Main Engine Operations	Main Engine Test Support
Ames Research Center	●	●	●																
Dryden Flight Research Center											●		●						
Glenn Research Center	●								●	●									
Goddard Space Flight Center	●					●													
Jet Propulsion Laboratory																			
Johnson Space Center	●	●	●	●		●	●	●	●	●	●	●	●	●	●				
Kennedy Space Center	●					●		●	●		●	●	●	●					
Langley Research Center	●					●					●								
Marshall Space Flight Center	●	●	●		●	●			●	●	●	●		●	●	●	●	●	
Stennis Space Center											●	●			●				●

Based on the FY 2004 President's Budget

Space Flight Enterprise Program | Program Category | Program Subcategory

	●									Main Engine Alternate Turbo Pump
	●									Reusable Solid Rocket Motor
	●			●						Solid Rocket Booster
				●						Orbiter
				●						Extravehicular Activity
●	●	●	●	●						**Service Life Extension**
●	●	●	●	●						Flight Hardware Safety Upgrades
●	●	●	●	●						Space Shuttle Facilities
●	●		●	●		●	●		●	**Launch Services**
●	●		●			●			●	**Expendable Launch Vehicle Support**
●	●		●			●				**Payload Carriers Support**
	●		●	●	●	●	●			**Space Communications**
				●						Operations and Integration
						●				Advanced Guidance Navigation
	●									Wide-Area Network
						●	●			Spectrum Efficient Techniques
							●			Spectrum Management
					●					Data Services
					●	●				Advanced Transceiver Techniques
●	●		●	●			●			**Rocket Propulsion Testing**
			●	●						**Crew Health & Safety**
●	●	●	●	●	●	●	●		●	**Advanced Systems**

Enhancing Coordination among NASA Enterprises

The following table describes how the NASA Enterprises support each other.

Space Flight Enterprise

- Functional and operational requirements for new technologies
- Spaceport launch facilities
- Integrate payloads
- Conduct experiments on the Space Shuttle and on the ISS
- Service space telescopes
- Launch robotic spacecraft on expendable launch vehicles
- Rocket propulsion testing
- Communications and data services
- Education and public outreach programs

Aerospace Technology Enterprise

- Advanced technology development and transfer
- Aerospace Technology Enterprise assets
- Systems analysis capabilities
- Technology problem-solving expertise
- Commercial technology transfer to Enterprises
- Orbital Space Plane
- Airborne sciences
- Education and public outreach programs

Space Science Enterprise

- Functional and operational requirements for new technologies
- Functional and operational requirements for launch vehicles
- Manage Deep Space Network
- Manage optical communications development
- Manage Astrobiology Program
- Provide space weather data
- Education and public outreach programs

Biological and Physical Research Enterprise

- Functional and operational requirements for new technologies
- Functional and operational requirements for launch vehicles and ISS
- Biomedical research
- Operational protocols
- Physical science design and safety standards
- Data measurement for Mars related to sustainable human presence and safety
- Education and public outreach programs

Earth Science Enterprise

- Functional and operational requirements for new technologies
- Functional and operational requirements for launch vehicles
- Study of Sun-Earth connection
- Adapt Earth system models to other planets
- Assist in improving aviation safety
- Study effects of global change on human health
- Ground network services
- Education and public outreach programs

Education Enterprise

- Guidance and integration of other Enterprises' education programs
- Linkages of NASA education programs to other Enterprises' future competencies and skill requirements
- Public outreach programs

Key

- Supports Space Flight Enterprise
- Supports Aerospace Technology Enterprise
- Supports Space Science Enterprise
- Supports Biological and Physical Research Enterprise
- Supports Earth Science Enterprise
- Supports Education Enterprise

Appendix 2

Captions

Cover — Astronaut Joseph Tanner conducts a spacewalk above the Space Shuttle Discovery's payload bay during mission STS-82.

Page ii — (top) NASA planes assume the Missing Man Formation over JSC during the Columbia memorial; (bottom) the crews of Columbia (STS-107), Challenger (STS-51L), and Apollo 1.

Page iv — Concept courtesy of the NASA Chief Scientist (Exploration graphic overlay courtesy of Leo Geiger, SAIC).

Page 1 — Astronauts repair and service the Hubble Space Telescope.

Page 2–3 — The Space Shuttle launches from KSC.

Page 6–7 — The Space Shuttle Discovery orbits the Earth with its payload bay doors open.

Page 8 — The Space Shuttle Columbia leaves a contrail as it passes through predawn clouds during mission STS-109.

Page 10 — The STS-113 ISS flight control team gathers at Mission Control Center-Houston.

Page 12 — Astronauts Leland Melvin (top) and Barbara Morgan (bottom) share their experiences with students.

Page 15 — (top) NASA strives to build and maintain a quality workforce; (bottom) information technology is critical to our mission success.

Page 16 — (left) Ground maintenance workers at KSC prepare to don gas masks before calibrating the fuel system for a Space Shuttle launch pad; (right) the Neutral Buoyancy Lab at JSC enables crews to train for ISS assembly in a virtually weightless environment.

Page 17 — (left) The JSC supports the Space Shuttle, the ISS, and various other human spaceflight research programs; (right) a transportation barge and a rocket propulsion test stand at SSC.

Page 18–19 — Artist's conception of human/robotic exploration on Mars (courtesy of Pat Rawlings, SAIC).

Page 22–23 — Astronauts John Herrington (left) and Michael Lopez-Alegria assemble the Port One truss on the ISS during mission STS-113.

Page 24 — Artist's conception of the ISS at International Partner Core Complete.

Page 25 — The ISS as seen from a vantage point aboard the Space Shuttle Endeavour during mission STS-97.

Page 26 — Astronaut Rex Walheim, STS-110 mission specialist, anchored by foot restraint to the ISS's Canadarm2, approaches the newly installed S-zero truss to install an airlock spur.

Page 27 — (left) Node 2 of the ISS arrives at KSC from Italy; (right) artist's conception of the ISS at U.S. Core Complete.

Page 28 — (top) Artist's conception of the Space Shuttle approaching the ISS at International Partner Core Complete; (bottom) pressurized Japanese Experiment Module being prepared for transport from Japan to KSC.

Page 29 Astronaut Ken Bowersox examines the progress of a zeolite crystal growth experiment aboard the ISS.

Page 30 ISS research: (top) Astronaut Don Pettit uses a microgravity science glovebox to conduct research; (bottom) Astronaut Peggy Whitson displays an astroculture experiment.

Page 31 Artist's conception of a future space outpost (courtesy of John Frassanito and Associates).

Page 32 The Space Shuttle Atlantis launches into the night sky.

Page 33 Viewed from the ISS, the Space Shuttle Endeavour (during STS-113) passes over the Cook Strait in New Zealand, where its namesake first sailed in 1770.

Page 35 (left) Space Shuttle Commander Eileen Collins reviews a flight plan; (top) a flight controller supports Space Shuttle operations from the Mission Control Center at JSC; (bottom right) astronauts service the Hubble Space Telescope.

Page 37 Space Shuttle Atlantis rolls out to the launch pad on the mobile launch platform.

Page 38–39 Artist's conception of four possible configurations for future crewed spacecraft.

Page 40 An Atlas II expendable launch vehicle at KSC prior to launching one of NASA's Tracking and Data Relay Satellites.

Page 41 The Space Science Enterprise's Deep Space One mission launches aboard a Delta II expendable launch vehicle.

Page 42 KSC workers prepare the Galaxy Evolution Explorer space telescope for launch.

Page 43 Workers at KSC conduct preflight spacecraft processing in support of the Mars Exploration Rover-B mission.

Page 44 The Mars Exploration Rover-B mission launches aboard a Delta II expendable launch vehicle.

Page 45 Artist's conception of a possible future launch vehicle (courtesy of John Frassanito and Associates).

Page 46 Artist's rendering of a Tracking and Data Relay Satellite (courtesy of The Boeing Company).

Page 47 Part of NASA's Deep Space Network, the 70-meter antenna at the Goldstone Deep Space Communications Complex in California supports interplanetary spacecraft missions and research.

Page 48 An essential component of NASA's Space Network, the TDRS ground terminal antennae at the White Sands Complex in New Mexico support the space communications needs of a variety of customers.

Page 49 Scientists and engineers monitoring Near Earth Asteroid Rendezvous mission data receive the first transmissions indicating that the spacecraft has successfully achieved orbit around the asteroid Eros.

Page 50 A sample of NASA's radio spectrum use for space communications.

Page 51 One of two 9-meter maneuverable antennae used for tracking Space Shuttle launches and landings from the Merritt Island Launch Annex Spaceflight Tracking and Data Network Station at KSC.

Page 53 A representative future space communications network architecture.

Page 54 A 750,000 pound-thrust rocket engine undergoes a test firing at MSFC.

Page 55 A rocket propulsion test at SSC.

Page 56 (top) Workers at SSC prepare a Space Shuttle Main Engine for a test-firing; (bottom) test engineers at SSC monitor a Space Shuttle Main Engine test.

Page 57 Twin Linear Aerospike XRS-2200 engines undergo testing at SSC.

Page 58 Astronaut Mae Jemison prepares a medical report during STS-47, a Space Shuttle mission dedicated to research on crew health and life sciences.

Page 59 Astronaut Dave Williams, a mission specialist representing the Canadian Space Agency, serves as a test subject for a Neurolab experiment aboard mission STS-90.

Page 60 Astronaut Edward Lu exercises on the Cycle Ergonometer and Vibration Isolation System on the ISS.

Page 61 Astronauts Jay Buckey, Jr. and James Pawelczyk conduct neurological tests aboard mission STS-90.

Page 62–63 Protecting humans in space, an artist's impression (courtesy of JSC and Tietronix Software, Inc.).

Page 64 Artist's conception of a scientific expedition on Mars (courtesy of Pat Rawlings, SAIC).

Page 65 Artist's conception of a solar electric orbital transfer vehicle (courtesy of Pat Rawlings, SAIC).

Page 66 (top) Wearing an advanced, lightweight space suit, Astronaut Nancy Currie evaluates the productivity gains of working with a Robonaut to accomplish extravehicular space assembly tasks; (bottom) Currie demonstrates the potential of human/robotic partnering in space exploration.

Page 66–67 The ISS is a springboard for pioneering new concepts in modular space construction.

Page 68–69 Artist's conception of human/robotic cooperation to construct a large space telescope (courtesy of Pat Rawlings, SAIC).

Page 70–71 Artist's conception of a possible lunar base (courtesy of Pat Rawlings, SAIC).

Page 74 (top to bottom) Artist's conceptions of potential space exploration missions: future space telescope assembly (courtesy of John Frassanito and Associates); a lunar expedition (courtesy of Pat Rawlings, SAIC); a spacecraft traveling to Mars (courtesy of John Frassanito and Associates); a scientific expedition on Mars (courtesy of Pat Rawlings, SAIC).

Page 74–75 The Sun and Earth, as photographed by the crew of Columbia (STS-107).

Page A-1 Time-lapse photography captures a launch of the Space Shuttle Endeavour.

Appendix 3

Acronym List

DOD	Department of Defense	**MHz**	megahertz
EELV	evolved expendable launch vehicle	**MSFC**	Marshall Space Flight Center
ELV	expendable launch vehicle	**NASA**	National Aeronautics and Space Administration
EVA	extravehicular activity	**NISN**	NASA Integrated Services Network
GHz	gigahertz	**SFE**	Space Flight Enterprise
GPS	Global Positioning System	**SLEP**	Service Life Extension Program
IT	information technology	**SSC**	Stennis Space Center
ISS	International Space Station	**STS**	space transportation system
JSC	Johnson Space Center	**TDRS**	Tracking and Data Relay Satellite
KSC	Kennedy Space Center		

SFE Strategic Planning Working Group
John Allen, Crew Health and Safety, SFE
David Brannon, Stennis Space Center
Raymond Brown, NASA Printing and Design
Lee Graham, Johnson Space Center
William Green, Launch Services, SFE
Daniel Hedin, Institutional Assets Mgmt., SFE
Lisa Jirousek, NASA Printing and Design
Michelle Kelly, Johnson Space Center
Melissa Kennedy, NASA Printing and Design
Jennifer Lyons, Kennedy Space Center
John Mankins, Advanced Systems, SFE
Michael McLean, Marshall Space Flight Center
Mayra N. Montrose, Office of the NASA Chief Scientist
Stephen Pitotti, Space Shuttle and ISS, SFE
Christopher Pino, Information Technology, SFE
David Schurr, Office of the NASA Chief Financial Officer
Robert Soltess, Institutional Assets Mgmt., SFE
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For more information regarding the work of the Space Flight Enterprise, please visit our Web site *http://spaceflight.nasa.gov*.

Now we stand at the edge of space, our gaze set upon the distant horizon.
Why venture farther, into the cold and the dark?
To learn the secrets of the wider universe, from which our world arose.
To search for other forms of life that we may better comprehend our own.
And, in the end, to be true to ourselves, and to our exploring ancestors,
Whose living legacy is that there will be no turning back.
We explore in space to learn, and be, who we are.
We explore to satisfy a human need: a desire written in every human heart.

National Aeronautics and
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